Railway Engineering Maintenance

STOP

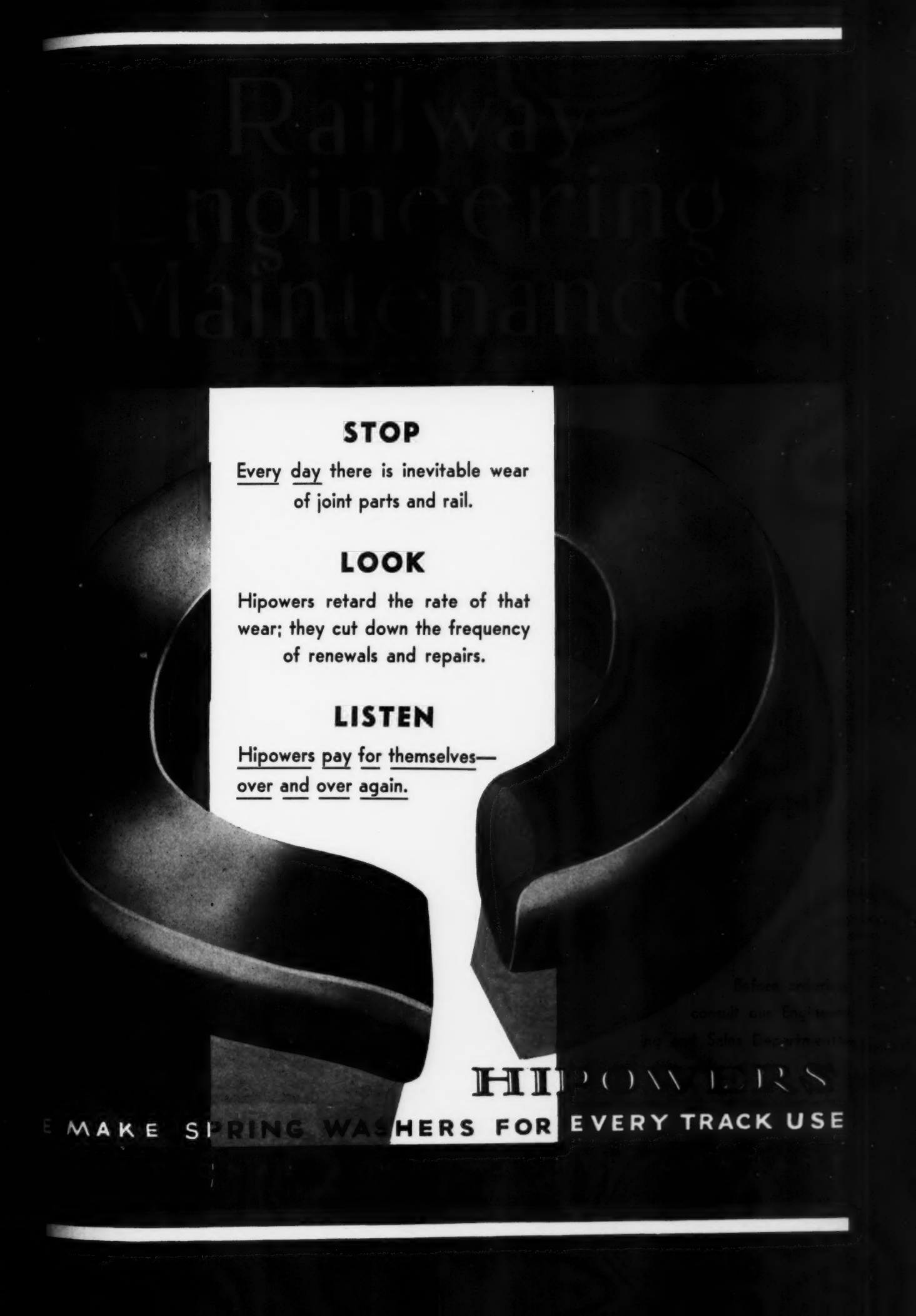
Every day there is inevitable wear of joint parts and rail.

LOOK

Hipowers retard the rate of that wear; they cut down the frequency of renewals and repairs.

LISTEN

Hipowers pay for themselves—over and over again.



HIPOWERS

MAKE SPRING WASHERS FOR EVERY TRACK USE

One of America's Famous Trains

SOUTHWESTERN LIMITED

CLEVELAND, CINCINNATI, CHICAGO AND ST. LOUIS RY.

DAILY the SOUTHWESTERN LIMITED, crack train of the Big Four Route, thunders by on time along the 1156 miles from St. Louis to New York, and over the 1215 miles from St. Louis to Boston. All-steel, air-conditioned, drawn by huge Hudson-type locomotives, this famous transportation institution personifies modern long-haul railroad service at its best. Here is the mighty Limited heading east at over 70 miles an hour past the Greencastle Station 40 miles west of Indianapolis over the double-tracked route, safeguarded by automatic train control. Dependable, comfortable transportation over high speed lines can now be further insured by operation of the rail signal system with HY-CROME *BONDING Spring Washers*—a definite safety factor.

Use HY-CROME *Spring Washers*

REActive Deflected	THACKERAY	HY-REACTION	STANDARD	HEAVY DUTY	DOUBLE	BONDING
Meets A. R. E. A. Spec.	*For screw spike use*	*For track bolts*	*For general use*	*For frogs—crossings*	*For special use*	*Used as rail*

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Sales Offices: New York • Cleveland • Detroit • Chicago • St. Louis • San Francisco • Montreal

200,000,000
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Prove Their Economic Value

WHEREVER Lundie Tie Plates are in use—the service rendered has been conspicuously outstanding. The Lundie performs all the functions of the ideal tie plate without resorting to means which are detrimental and destructive to ties.

Lundie tie plate service is superior because:

It prevents the widening of track
The plate does not slip or kick out
No tie destroying projections are needed
The plate seats itself perfectly
It gives proper inclination to rail
It protects ties against mechanical wear
Does not cut a single tie fibre.

The reason: The Lundie bottom consists of multiple bearing areas, with each surface normal to the resultant of the vertical and lateral loads on the tie.

It is the only essentially flat bottom tie plate that holds gauge.

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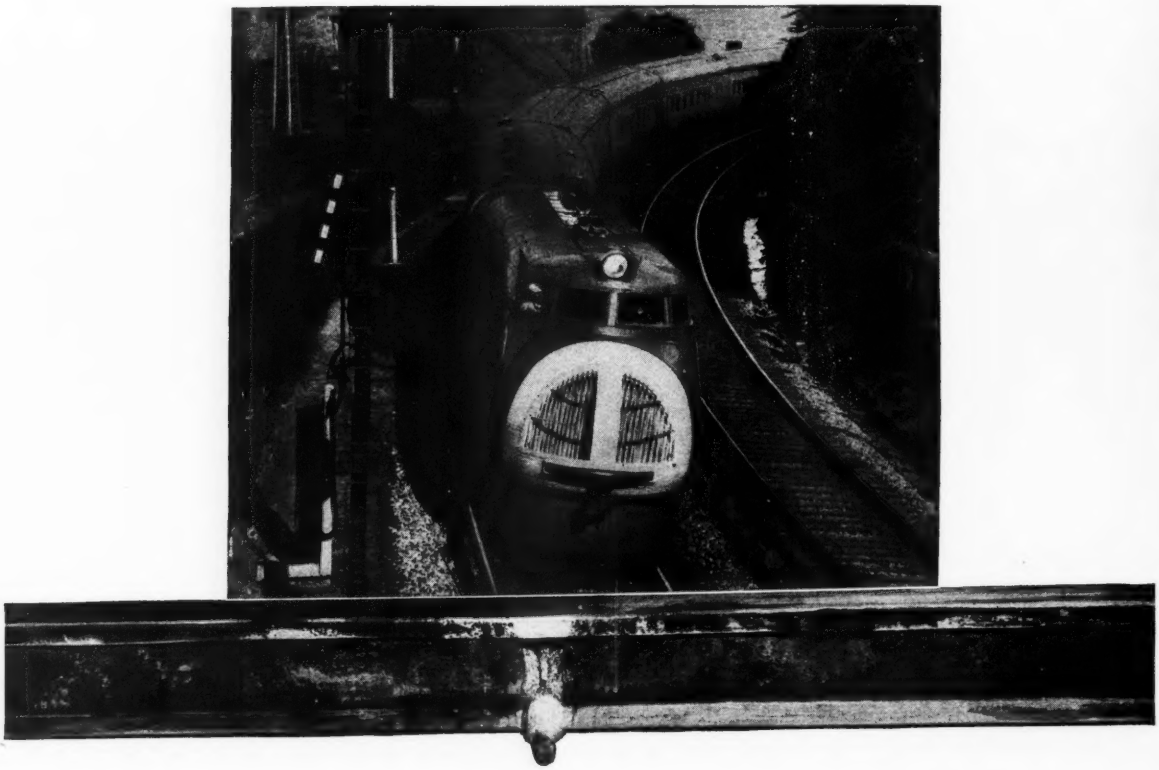
Tie Plates—Ardco Rail and Flange Lubricator

285 Madison Avenue, New York 59 E. Van Buren St., Chicago

LUNDIE TIE PLATE

Published monthly by Simmons-Boardman Publishing Company, 105 W. Adams St., Chicago, Ill. Subscription price, United States and Possessions, $2.00; Canada, $2.50; Foreign, $3.00. Single copies 35 cents. Entered as second-class matter January 20, 1933, at the postoffice at Chicago, Illinois, under the act of March 3, 1879, with additional entry at Mt. Morris, Ill., postoffice. Address communications to 105 W. Adams St., Chicago, Ill.

Higher Speeds mean Greater Impact—



THIS JOINT CAN TAKE IT

AND, the reason is: a Thermit Rail Weld is not a joint. Instead, it actually eliminates the joint and forms rails into continuous stretches of homogeneous steel. There are no gaps or rough spots for wheels to pound . . . no rail ends to batter . . . in Thermit Welded track.

The economies made possible by Thermit Rail Welding are enormous. Joint maintenance is banished. Frequent track lining and surfacing become unnecessary. Rail life, it is estimated, is increased 25% to 40%. Wear and tear on rolling stock and motive power are reduced.

Installations of long welded rails in Europe, Australia and America . . . some of them in service for the past eight years . . . prove that rail welding is safe, sane and practical. No trouble from expansion and contraction has ever been experienced.

Thermit Rail Welds can be installed by your own track forces at a cost comparable with ordinary rail joints . . . and, the first cost is the last. Write for the complete story.

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Offsetting distant Set-Offs

When the section crew has to walk to the job from crossings or distant set-offs, it means a waste of time and money.

The Fairmont M14 Series D offsets this problem because it is a lightweight car that goes right to the job; that can be easily handled by one man —and that has both the power and the room to carry a full crew of 6 to 7 men with complete tool equipment.

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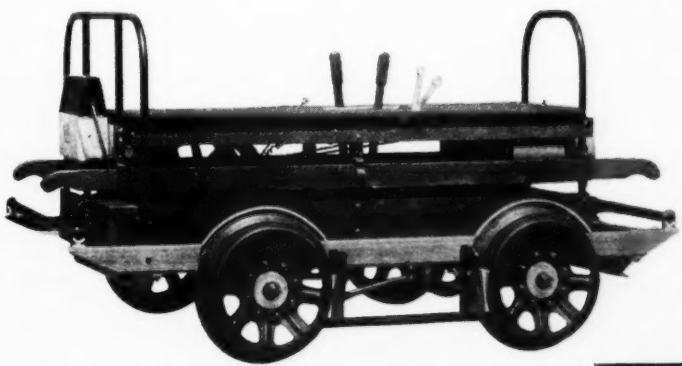

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of your AIRCO-DB Welding Torch

with the new

AIRCO-DB TWO-FLAME TIP

Two torches in one—that's what it amounts to when you screw this TWO-FLAME TIP to the handle of the regular AIRCO-DB Welding Torch. By providing double the amount of heat, the temperatures required in building up rail ends and in heat treating, are reached much faster and with less dissipation of heat through the rail. Obviously this means a saving of gases and material as well as time. Use the AIRCO-DB TWO-FLAME TIP and cut the cost of your rail end welding and heat treating. WRITE for details.

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HIGH SPEED TRAIN OPERATION

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● Rail with battered or chipped ends will not permit the operating economies inherent in the new light-weight, high-speed, streamlined trains. You can, however, have your rail in smooth-riding condition without requiring additional funds for track maintenance.

Building-up rail ends by oxy-acetylene welding with metal harder than the original rail has made thousands of miles of old rail ride like new. In almost every instance, the cost of welding has been more than offset by reduced cost of joint maintenance.

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The Oxweld Railroad Service Company shows you how to accomplish these applications economically. Through this source, you can secure the latest information on any of the thousands of oxy-acetylene welding and cutting applications which are contributing greatly to railroad operating economies.

OXWELD RAILROAD SERVICE

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Unit of Union Carbide and Carbon Corporation

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Carries Six • Light Weight • Air Cooled Engine • Sheffield Drive • Trouble-Free Operation • Plenty of Clearance • Heavy Axles • Timken Bearings • 4-Wheel Brakes

Light enough for a one-man patrol car —and yet sturdy enough for six men on full crew section work, the Fairbanks-Morse "Sheffield 49" is the best motor car buy on the rails.

Study these features that mean extra performance—extra value in year-in-year-out service:

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See the new Fairbanks-Morse "Sheffield 49." It costs no more to profit by the years of Sheffield design and experience. For complete information on the "49" and its companion four-man track inspection car "48," write Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill.

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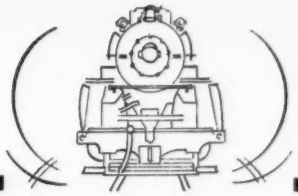

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Another Prominent Railroad

erects Armco Metal Cribwall

TO REPLACE FAILING WING WALLS

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Armco Metal Cribbing replacing failing wing walls on an important railroad line. The sturdy metal cribbing units were bolted together to form a strong, durable wall.

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Ask the Armco engineer for complete data on some of the Armco Metal Cribwalls put in by other responsible buyers.

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For retaining walls

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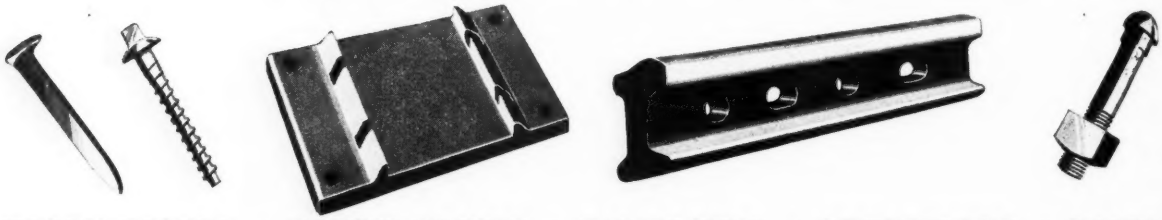
Don't misunderstand us: we're not trying to claim that Illinois Track Materials will solve all your problems. But they'll help keep tracks smooth and even. Because their quality and their uniformity can be relied on.



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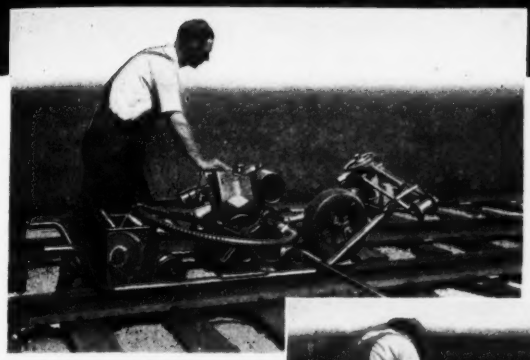
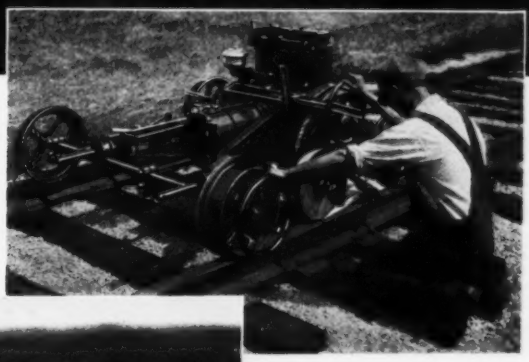
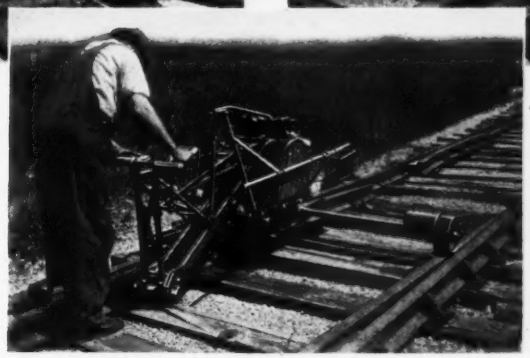
United States Steel Corporation Subsidiary

JOINTS THAT MUST BE MAINTAINED

Here are three unusual machines built for this class of work







Utility Grinder

Surface Grinder

Track Wrench

With the two new Nordberg Grinders and the Track Wrench, joint maintenance is simplified, better riding track is secured and the cost of joint maintenance is greatly lessened.

The appliances that Nordberg has developed for the new Utility Grinder makes this the most useful machine of its type so far designed for railroad work. It is a valuable tool in every yard and terminal for grinding switch points, stock rails, frogs and crossings, also for smoothing off mill tolerance and difference in height of newly cropped rail.

Then there is the new Surface Grinder, a fast cutting machine for those who are doing heavy duty welding.

For periodical joint maintenance and as part of the equipment of the rail laying gang, there is the Track Wrench that provides joints of uniform tightness at greater speed and less expense.

Other Nordberg Tools used for maintaining track

Adzing Machine

Spike Puller

Power Jack

Rail Drill

Track Shifter

NORDBERG MFG. CO., MILWAUKEE WISCONSIN

No. 76 of a series

Railway
Engineering and Maintenance

SIMMONS-BOARDMAN PUBLISHING COMPANY

105 WEST ADAMS ST.
CHICAGO, ILL.

Subject: Old Friends

March 28, 1935

Dear Reader:

When I wrote you on July 27 (letter No. 68, August issue) to inquire regarding the oldest reader of Railway Engineering and Maintenance, I expected to receive a number of replies. I had not expected, however, that I would receive as many replies as I did or that they would come from such widely distributed areas. Letters came in from points as remote as England and Hawaii, and from various parts of the United States, all evidencing interest in the publication that they have been reading for so many years. I quote from three:

G. B. McClellan, general roadmaster of the Texas & Pacific, Marshall, Texas: "I first saw a copy of Railway Engineering and Maintenance in 1917 and have been a subscriber continuously since 1922. I never miss an opportunity to boost it among my foremen, nearly all of whom are also subscribers. It does not seem to me that a man who is content without this publication can be much interested in trackwork."

C. R. Knowles, superintendent water service, Illinois Central, Chicago: "I have been a continuous reader of Railway Engineering and Maintenance for more than 20 years, and have in my files every issue since June, 1914. To substantiate this claim, I attach a photostat copy of the front cover of this issue."

W. D. Cleveland, signal supervisor of the Oahn Railway of Hawaii, Honolulu: "I first subscribed for Railway Engineering and Maintenance in 1917, and since 1920 have shared a copy with the chief engineer. It may seem strange for a signal engineer to be interested in a maintenance magazine, but I have learned that if one wants to keep up in railroading, he must be familiar with the other fellow's activities as well as his own. It may interest you to know that some of the devices now used in track maintenance on this railway first came to our attention through advertisements in Railway Engineering and Maintenance."

These are typical of other letters that we have received and which we will refer to in later issues.

We appreciate the friendly interest that is reflected in these long-continued subscriptions. We appreciate also the fact that so many of you have taken the time in these busy days to write us of your interest.

Yours sincerely,

Elmer T. Howson

ETH*JC

Editor

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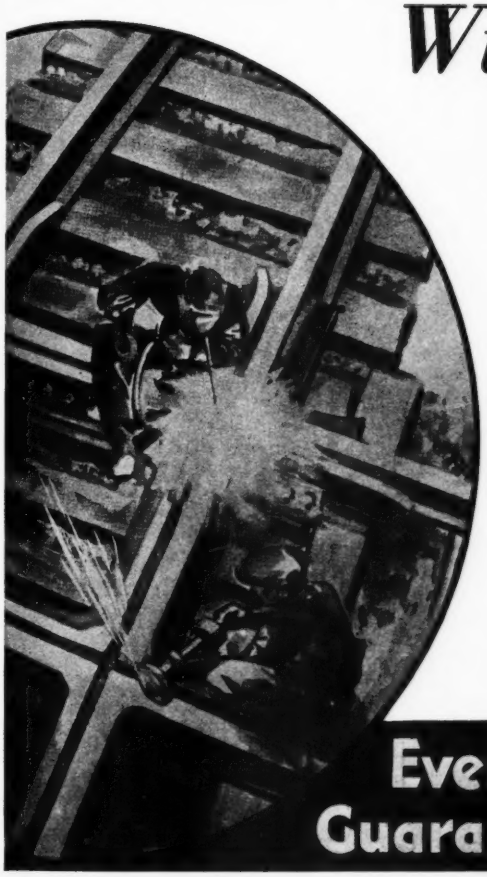

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MORRISON specializes in *reconditioning* frogs and crossings by *welding* . . . giving added service life and smooth riding at a fraction of the cost for replacements. MORRISON works *"in track under traffic,"* thus eliminating removal costs. MORRISON quality always assures the *Lowest Cost per Job!*

Morrison Metalweld Process—Patent No. 1994479

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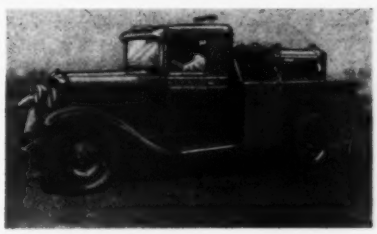
MORRISON Welding Units are *GOING PLACES* All Over the U. S.!

MORRISON units are available on short notice. Their work is speedy and accurate. MORRISON offers INSPECTION and CONSULTATION SERVICES *without cost or obligation.* It will pay you to investigate . . .



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Railway Engineering and Maintenance

NAME REGISTERED U. S. PATENT OFFICE

April, 1935

Editorials - 213
Government Ownership — Machines — Ballast Floors — Drainage — Preframing

Claw Bars, Lining Bars, Tamping Bars - - - - - - - - - - 216
This is the fifth article of a series dealing with the multiplicity of designs in track materials and tools

Flatter vs. Grinder in Rail Welding - - - - - - - - - - - 221
G. M. O'Rourke gives the results of time studies made to determine the relative costs of these two methods as applied to welding

Are You Proud of Your Road? - - - - - - - - - - - - - 223
C. W. Engle urges the development of pride of ownership as a means of getting more satisfaction out of the job

Preframing Proves Practical - - - - - - - - - - - - - - 224
L. G. Byrd describes the methods employed on the Missouri Pacific in precutting and preboring timbers for trestle construction

Roofs - 226
Third article of a series, based on the practices of the Northern Pacific, gives rules for the application of Dutch-lap asbestos shingles

Treating Ties With Z.M.A. - - - - - - - - - - - - - - - 228
Results of test installations lead Great Northern to broader use of this preservative and zinc chloride

The Problem of the Smoke Stack - - - - - - - - - - - - 229
Changes in design and material used as a means of obtaining longer life—practices in dismantling and erection

Fissure Data Show New Trends - - - - - - - - - - - - - 230
Operation of detector cars develops pertinent facts concerning prevailing sizes of these defects and the rate of growth

Derailments Can Be Prevented - - - - - - - - - - - - - 231
A. H. Peterson describes various precautions that should be observed to keep track safe for train operation

What's the Answer - - - - - - - - - - - - - - - - - - 233

New and Improved Devices - - - - - - - - - - - - - - - 240

What Our Readers Think - - - - - - - - - - - - - - - - 241

News of the Month - - - - - - - - - - - - - - - - - - 243

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—at track level

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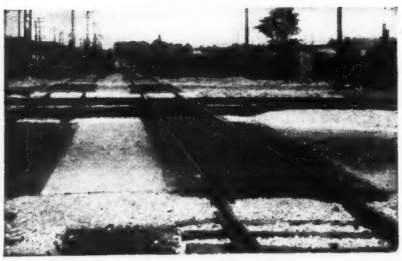
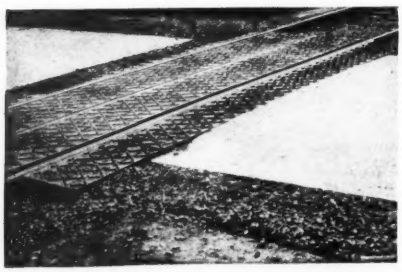
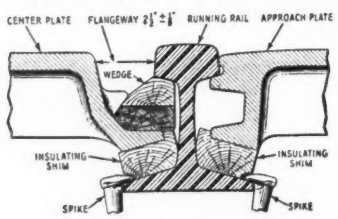


Detroit Terminal R. R. Co., Oakland Blvd., near Grand River Ave., Detroit, Mich.



Rock Island, Ponca City, Oklahoma.



Section at running rail

1st.—They stay PERMANENTLY at track level, because the plates are supported by the BASE OF THE RAILS and therefore always follow the rail level.

2nd.—They are indestructible, more so than high test manhole covers, and will stand up for over twenty years under any traffic allowed on public roads. The individual plates are easily handled, easily installed or removed. They are toe checked on top to prevent skidding and heavily ribbed on the underside for *strength*. No special track preparation needed to put down.

3rd.—A metal non-skid highway with effective insulation between the R. R. running rails.

In short, the hundreds of crossings equipped with these plates prove beyond question that the original installation is practically the LAST COST, in spite of heaviest traffic, frost or other elements that play havoc with less permanent forms of construction.

Why not visit an installation near you? That's the BEST PROOF. Write us — and we'll be glad to advise location.

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Railway Engineering and Maintenance

Government Ownership

Is it a Reform or a Menace?

LIKE prohibition, government ownership of the railways appears to be a topic for interminable discussion in the United States, for it is continuously being thrust into the forum of public debate. Only a few days ago, Senator Burton K. Wheeler, chairman of the Senate Committee on Interstate and Foreign Commerce, announced that he would soon introduce into Congress a bill providing for government ownership. Similarly, Joseph B. Eastman, federal co-ordinator of transportation, while stating that he believes the time to be inopportune for active consideration of this problem, has kept the subject alive by his repeated references to it in reports and public utterances.

Problem Cannot be Ignored

Coming from sources of such prominence, this issue cannot be ignored. It is one which is of direct import to every citizen and especially to those with property; it is of even more direct concern to those who are employed by the railways. It is essential that they be acquainted with the facts in order that they may not only be able to determine what is best for themselves but also may be able to counsel with those who are less fully informed than they are.

Agitation for public ownership is not confined to the railways. The government is entering into participation in the active control of business today to a degree unthought of only a few years ago. It is openly proposing to engage in power development and sale in competition with privately-owned companies. It is participating less directly but no less effectively in the operation of banks through the appointment of directors and, in some instances, of executive officers. Similar inroads are being made in the control of other industries.

Not a New Experiment

Neither is government operation of railways a new experiment, for 42 per cent of the railway mileage of the world is publicly-owned, while 58 per cent is privately owned. The proportion of the mileage that is publicly-operated is slightly less, for some of the publicly-owned mileage is leased to private companies for operation.

Of the 355,800 miles of railways owned by the public, 52,000 miles is in Russia, 33,425 in Germany, 31,690 miles in India, 10,512 miles in Italy, about 12,000 in Japan, 12,450 in Poland, and 13,151 in the Union of South Africa. Of the 492,200 miles of privately-owned railways, 307,367 miles are in the United States, Great Britain and France. In other words, about five-eighths of the privately-owned mileage is in those countries which constitute the great democracies of the world, while nearly half of the publicly-owned railways are found in countries where government is highly centralized, and individual initiative is limited.

Some Results

Government ownership of railways is not, therefore, an untried theory. It is possible to ascertain the results, and the figures are illuminating. Although 1934 figures are available for the railways of the United States, 1933 is the latest year for which comparable data are available for the railways of other countries.

In 1933, the roads of the United States had a net operating income of $474,212,304, representing a return of 1.8 per cent upon property investment. Their operating ratio was 72.67. In Germany, the government-operated railways had an operating deficit of $32,394,000 and an operating ratio of 104.67. In Italy, the state-operated roads earned a deficit of 603,000,000 lire and their operating ratio was 119. In Belgium, a country of high traffic density, the state-owned system of 3,000 miles operated at a deficit of 168,502,000 francs, with an operating ratio of 106.87. In Denmark, the 1,500 miles of government-owned lines had an operating ratio of 114, while the state-owned railways of Norway operated with a ratio of 111.5 per cent.

France affords an interesting comparison by reason of the fact that 19,000 miles of its railways are privately-operated and 7,000 miles are operated by the government. Here, while both groups operated at a loss in the years 1923 to 1932, the net deficit per mile per year on the government-operated lines was 60,161 francs, while that on the privately-operated lines amounted only to 23,515 francs.

Coming closer home, we have a most interesting and illuminating comparison in Canada. Here the conditions as to traffic and distances are more directly comparable with those in the United States. Canada is served essentially by two railway systems, the publicly-owned Canadian National, with 23,743 miles of lines and the privately-owned Canadian Pacific, with 17,017 miles. The investment per mile on the Canadian National is $90,057, on the Canadian Pacific it is $68,700. In the period

1923-33, the net income of the Canadian Pacific was $330,392,205, while the net deficit of the Canadian National was $646,632,743.

In 1933 alone, the Canadian National deficit, after payment of such taxes as are assessed, was $96,051,854, while the Canadian Pacific had net earnings of $20,862,106. Furthermore, during the 16 years since the Canadian government took over the Canadian National Railways, it has advanced nearly $704,000,000 for both capital expenditures and deficits, without payment of $417,390,941 interest accrued since acquisition.

But we can come still closer home, for on January 1, 1918, the government of the United States took over and operated the railways of this country for a period of 26 months, only 10½ months of which were during the war, with results so unsatisfactory financially as well as from a service standpoint, that the public demanded in no uncertain terms that they be returned to their owners.

A Menace

To those who profit from experience, the experiences cited above should be sufficient to demonstrate the utter lack of economic justification for the transfer of railway ownership to the government. The evidence from other countries, as well as our own experiment, is so overwhelming as to serve as a warning against any such action. Under a government such as ours, it cannot do other than make the properties a political football, to be operated for political purposes. That even such an outspoken advocate of government operation as Co-ordinator Eastman recognizes this danger is evidenced by his statement in his report to the Interstate Commerce Commission that "it would be dangerous to take so far-reaching a step until the country is prepared to welcome it and to lend it the support and protection which are essential to its success."

From the standpoint of the public, the hazard is great. It is equally so from the standpoint of the employee. In the first place, the operation of the railways by the government will lead at once to the regimentation of employees as in the postal service. Activities will be standardized to the point where individual initiative will be suppressed.

Equally repressive will be the result as to wages. While direct comparisons are difficult because of varying costs of living in different countries, W. N. Doak, formerly vice-president of the Brotherhood of Railroad Trainmen, made the interesting statement several years ago that while the weekly wages of a conductor in the United States would buy 840 lb. of bread, it would buy only 257 in Switzerland, 238 in Germany and 189 in Italy, in all of which railways are publicly owned. It can be seen, therefore, that the employee will suffer equally with the public in any trend towards government ownership.

The agitation for government ownership of railways is a menace alike to the property owner, who would be taxed to make good the deficits from public operation; to the user of railway service who would be deprived of the benefits of improvements in service induced by competition and private initiative, and to the employee, who would be subjected to all the red tape and regimentation now found elsewhere in government service. It is advocated only by those of socialistic tendencies and those who see in it an opportunity for political advantage. For these various reasons, it constitutes a menace of high order which should be combatted at every opportunity by every employee of a railway who has an interest in his future and a desire to serve the interests of his community.

Machines

The Opportunities Have Not Been Exhausted

THE knocking out of the rear wall of a roundhouse stall and the construction of a hundred feet or more of track, to enable a locomotive crane to reach the site of a smoke stack and be used in replacing it with a new one, illustrates the efficiency of modern hoisting equipment. The expenditures incurred to permit the use of the crane were not authorized until studies had demonstrated that this procedure would be cheaper in the end than the use of a gin pole or stiff-leg derrick set up at the site.

This incident could be cited, also, as an example of meritorious initiative, but for the fact that railway maintenance officers have long enjoyed a reputation for resourcefulness. Too often in the past, however, such resourcefulness has been forthcoming in the face of difficulties arising out of a lack of suitable equipment to accomplish what was needed with whatever means were available. In the illustration cited above an effective machine was available, but in how many other cases are cumbersome methods employed because the machine that would do the job properly has not been bought?

The enviable records of the maintenance of way departments of American railroads in the reduction of costs have resulted in no small part because maintenance officers have not hesitated to urge the acquisition of new equipment that could do work cheaper and better than the machines already owned.

Ballast Floors

What Are Their Advantages Worth?

BALLAST floors have been used so extensively on railway bridges for such a long time that the economic justification of their greater cost, as compared with an open deck, as applied to many structures is now rarely a subject of discussion. The ballast deck has several obvious advantages, among which none is more important than the facility it affords for adjustment of the line and surface of the track by the track forces.

With ballasted track on bridges the difficulty of making the transition of the track surface from the ballasted track on the approach to the structure-supported track on the bridge is eliminated—a point that is of special importance where there are a number of bridges only a short distance apart. This explains the popularity of ballasted floors on track elevation bridges in cities, although in this case the requirement that the structure be waterproofed is an added incentive for a type of construction readily adapted to ballasted track.

On the other hand, the ballast floor calls for a greater floor depth and because every additional inch of floor depth in a track elevation project costs money, designers have gone to considerable pains to design solid floor structures in which the rails are attached directly to the floor without the introduction of either ties or ballast, and a few structures of this type have been built. The feasibility of such floors, from the construction standpoint, is the problem of the designer, but their practicability from the standpoint of maintenance is a matter that concerns the maintenance officer, not only in-so-far as it involves the permanence of the structural details but also at it affects the problem of maintaining good surface on the track adjacent to these bridges with the requirement that it cannot be raised in surfacing operations.

Drainage

Permanent Solution Is Economical Solution

EVERY maintenance of way man, and, fortunately, almost every general officer realizes the importance of adequate drainage as a requisite of smooth-riding and economically-maintained track. This has been evidenced in many instances during the last few years of depressed railway income and, therefore, of reduced maintenance of way allowances, as ditching, ballast cleaning, cut-widening and culvert work have been continued by many roads, reduced in extent of necessity in many cases, but often assuming a larger proportionate part of the total maintenance of way budget than in more normal years.

Some maintenance officers have been stopped from improving drainage conditions by lack of funds where they know definitely that corrective measures should be taken and, furthermore, that their inability to apply such measures is taking an abnormally high toll in rail and tie life and in unnecessarily large expenditures for general track maintenance. Equally unfortunate is the application of inadequate drainage measures where major operations are known to be required and where funds can be made available for the more comprehensive work. All too often this condition has been found to exist. This may be the result of a short-sighted policy on the part of the management, uninformed or not completely sold to the immediate and lasting economies of permanent track drainage, or it may be the result of the desire of the maintenance of way department to reduce expenditures in accordance with some arbitrarily restricted budget.

In some cases, ignorance of the true cause of specific drainage problems is the real reason for the adoption of inadequate corrective measures. This does not necessarily imply reflections upon the maintenance of way department. In fact, in view of the extensive mileage involved, the multiplicity of geological and artificial conditions existing along and beneath the railways, and the dearth of funds available generally for adequate investigations to ascertain true sub-surface conditions, it is to the credit of maintenance men that they have been as successful as they have in coping with their drainage problems.

Whatever the reason, it is only too true, however, that many drainage problems have been "played with" for years. That is, surface remedies have been applied that have proved repeatedly to be of only temporary benefit. The unfortunate fact is that these temporary remedies have frequently eaten into the maintenance budgets far more deeply than if major, somewhat more costly, yet permanent remedies had been applied in the first place.

A deep-rooted chronic sore often cannot be cured effectively by surface treatment, but may require a major operation, performed or directed by a specialist. So it is with many railroad roadbed drainage problems. Fortunately, as with surgery, the technic is fully known and, for such cases as may require, the services of specialists are available.

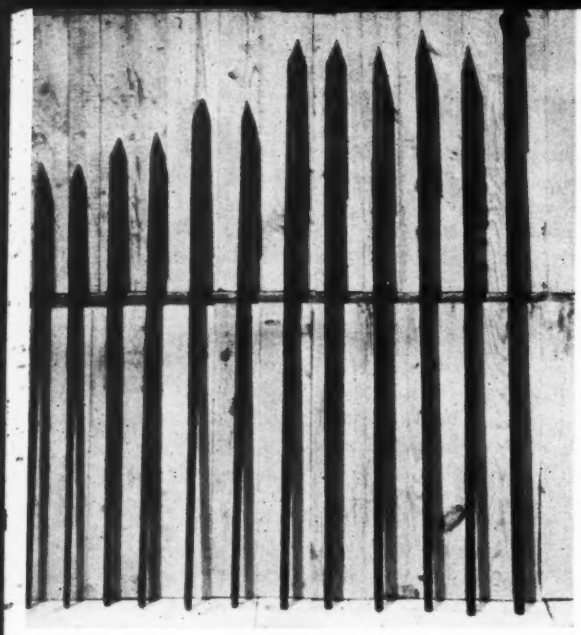
An article in the February issue described how one road is getting at the root of a number of its chronic drainage problems. There may be those who will question specific details in the methods and means being employed by that road, but there cannot be other than an agreement that the circumstances which prevailed justify the cure, and that the expenditures being made will return handsome dividends in reduced expenditures for track maintenance and in a stronger, safer and smoother-riding track structure.

Preframing

Should Present Stringers Have Butt Joints?

WHILE the framing of timbers for pile and frame trestles and for the decks of steel bridges before treatment is by no means universal as yet, this practice has been adopted as standard by many railways and is widely recognized as a means of insuring greater service life from treated wood. Like any other practice that is still in the development stage, it is subject to variations in the degree of refinement observed in its use. What some deem thoroughly practical measures are considered by others as entailing unwarranted accuracy in detailing and workmanship.

This point is well illustrated by the difference of opinion that has developed with respect to the preframing of timbers for trestles. While there is rather general agreement concerning the preboring of caps and the preboring of stringers for chord bolts, there is a decided divergence in views concerning the practicability of cutting stringers to exact lengths for butt joints on the caps, as described in the article on page 224 of this issue. Butting the ends of stringers that are not to be cut in the field implies the driving of the bents with a higher degree of accuracy than has commonly been done in the past, and it is the contention of some bridge maintenance officers that this refinement in locating the bents cannot readily be obtained, especially where a trestle has been redriven several times and the ground contains several rows of pile stubs in each panel. For this reason, a number of roads prefer to use a lap arrangement of the stringers, with a type of fastening to the caps that will allow some latitude in the spacing of the bents. Contrary to this practice, however, the author reports that he has encountered no difficulty in driving bents to fit the precut butted stringers.



Variations in the Designs of Lining Bars Increase the Production Costs

Claw Bars Lining Bars Tamping Bars

Can They Be

LINING bars, tamping bars and claw bars are included in the equipment of every track gang. They are among the earliest tools devised for track work. They are relatively simple in design. For these various reasons, it would normally be expected that they would be of one, or at the most, a relatively few, more or less standard designs. Yet there is a wide variety of designs for each of these tools. Not the least striking feature of this diversity is the fact that, with few exceptions, it results from minor differences in non-essential dimensions which do not affect the utility of the tools in practical service.

The Lining Bar

No tool could be simpler than the lining bar. It is essentially a straight bar of steel having the lower end pointed and the upper part rounded to protect the hands of the user. Designs have been conventionalized to the extent that practically all lining bars consist of a pointed section (G), a square section (D), an octagonal section (C) and a tapered round section (B), although a few designs replace the octagonal section with one hexagonal in shape (the letters refer to dimensions on the drawing).

The very simplicity of this basic design would seem to limit the number of variations that are likely to occur. Yet the lining bar is produced in a greater diversity of designs than any other track tool except the wrench, a single manufacturer being required to make 144 different sizes and shapes of this simple tool to meet the requirements of his patrons. Lining bars vary in weight from 10 to 30 lb. and in length from 4 to 6 ft., while the cross-sectional area ranges from 1 to $3\frac{1}{8}$ sq. in., the square dimension increasing from 1 to $1\frac{3}{4}$ in. by increments of $\frac{1}{8}$ in.

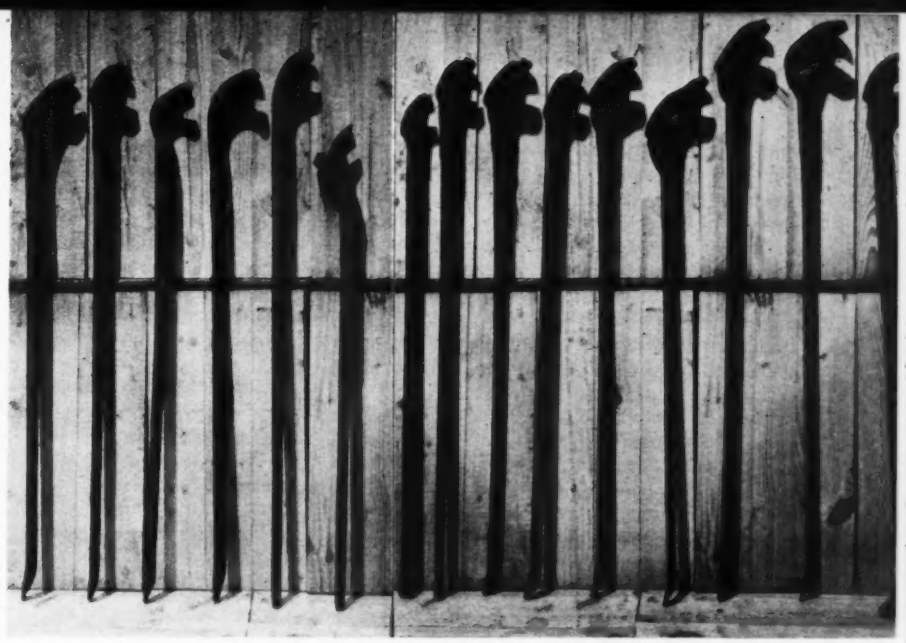
Four types of points are in common use—round, diamond, wedge and pinch shapes. Some roads confine their designs to a single type of point, while others require two or more. It is not difficult to understand a preference for flat points, represented by the wedge and pinch shapes, or for the pencil and diamond shapes, but it is not so apparent why the length of the point should vary from 2 in. to 6 in., with a few designs as short as $1\frac{1}{2}$ in. Furthermore, some roads demand different lengths, ranging from 2 to 6 in., for points of the same type, while others specify the same length for all types.

There is little reason to believe that there will be any appreciable difference in the serviceability of lining bars having points 2, $2\frac{1}{8}$ or even $2\frac{3}{8}$ in. long, or between others in which the points are $3\frac{1}{2}$, 4 or $4\frac{1}{4}$ in. long, particularly if they are of the same type. That the length of the point is not considered to be a function of its shape is indicated by the fact that some roads specify the same length for the two or three types that they employ. Yet, between the limits that have been mentioned, variations in the length of points occur in bars of all cross-sectional dimensions in increments of $\frac{1}{8}$, $\frac{1}{4}$ and $\frac{1}{2}$ in. in all types, the larger increments being near the upper limit of the length.

Similar differences occur in the square section of the bar. It is this part of the tool that has the greatest cross-sectional area, and, as has been mentioned, the square dimension varies between 1 and $1\frac{3}{4}$ in. In general, this dimension increases with the length of the bar, although there are numerous exceptions. Again, dimension D, which includes the point, ranges from $12\frac{1}{2}$ to 20 in., usually by relatively large increments, although in numerous instances it bears no relation to the thickness of the bar or the length of the point. Furthermore, in the designs studied, no relation is evident between D and the total length of the bar (A), since in some of the designs for long bars D is less than in others that are shorter, while designs of varying overall length use the same value for D. Obviously, considerable variation occurs in the actual length of the square section by reason of the variations in the value of D combined with the many and small differences in the length of the point (G).

Other Variations

Designs for the octagonal part of the bar (C) show similar variations. While the length of this part of the tool is generally from 14 to 16 in., a number of variations occur both above and below these limits. Even within the narrow limit of two inches, however, numerous differences in the value of C are found. Again, it is



Is there any Practical Difference in the Efficiency of these 15 Claw Bars?

ney Be Standardized?

This is the fifth article of a series dealing with the multiplicity of designs in track materials and tools. In the first article, in the November issue, the general problems of standardization were set forth. In succeeding articles, in the December, January and February issues, specific problems connected with rail, track wrenches and tie plates and their standardization were discussed. The present article deals with lining bars, tamping bars and claw bars, and the problems facing the railways and manufacturers by reason of the multiplicity of designs for these tools. Joint bars will be discussed in May.

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apparent that the length of this part of the bar bears no relation to any of the remaining dimensions, one of the longest bars having a value of only 12 in. for C, while this value is as much as 15 and 16 in. in some of the shorter ones.

Variations in the upper part, or handle, of the bar are found with respect to length, diameter and taper. Obviously the length of the handle varies with the overall length of the tool and the values of C and D, so that the number of differences almost equals the number of designs. The diameter also depends on the size of the stock from which the tool is made, and the taper, the situation with respect to taper being somewhat similar to that found in the handles of track wrenches. Some roads apparently desire a long slender handle, while others prefer one that is short and thick. In other cases the more pointed handles are found on the shorter lining bars while blunt ends are placed on the longer tools. Because of these preferences, the diameter (H) of the upper end of the tool ranges from ½ in. to 1 in., with differences as small as $\frac{1}{16}$ in.

These comparisons, which have been gleaned from a large number of individual designs of lining bars, indicate the multiplicity of designs for this simple tool. They also lead to the question whether these differences are of sufficient consequence to affect utility. In other words, will a trackman detect any difference between a bar in which C is 15⅜ in. and another in which this dimension is 15¼ in.? Will he note any difference in the serviceability of two bars that are 66 and 67 in. long, respectively? Similar comparisons can be drawn for other differences in designs, but these examples demonstrate that, for the most part, the great multiplicity of designs for this simple tool arise because of personal preferences of the designers.

Tamping Bars

The number of designs for tamping bars is much smaller than for lining bars. The tamping end invariably consists of a flat blade set at an angle with the main axis of the bar, the width and thickness of which may quite obviously be expected to vary somewhat with the character of the ballast in the track where it is to be employed.

The width of the blade varies from 3 in. to 4 in., although one road calls for a width of 3⅜ in., while another requires 3½ in., and a third insists on 3⅝ in. The blade may be of uniform thickness or tapered, the range in thickness being from ¼ in. to 1 in., with differences as small as $\frac{1}{16}$ in., while in the tapered designs the length of the taper ranges from 2¼ to 3½ in.

Although the angle between the blade and the main axis of the tool varies within relatively narrow limits, the number of these variations is large and these differences seem to be a matter of personal preference rather than well-considered design, since in numerous instances the differences involve only a few minutes of angle. The manner in which this angle is obtained also differs, some designs calling for a simple bend, while others require reverse bends, with variations in the length of the respective radii and arcs.

The stock from which this tool is made is either round or octagonal, the diameter in each case being either ⅞ in. or 1 in. A number of designs require, however, a square cross section for four or five inches above the

bend for the blade, the square dimension being the same as the diameter of the shank. Different designs also require different overall lengths, between five and six feet, with differences as small as ¼ in.—far less than the tolerance allowed in most specifications.

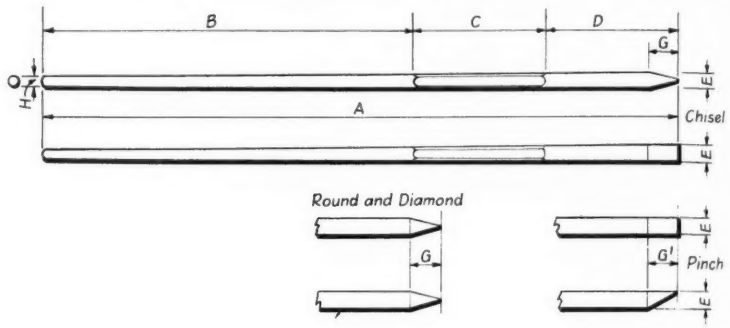
Another place where much latitude in design occurs is at the upper end of this tool. This may be either plain or of the chisel, spear or grab types. In some designs a second tamping blade is required, which may be a duplicate of or differ from the first blade. Numerous variations occur in the length, width and angle of the chisel blade, some having their axes continuous with the bar, while others are bent as much as 30 deg. Similar variations occur in the length, width and shape of the spear points, while in some designs the spear point is rotated 90 deg. to bring it at right angles to the generally accepted design for a tamping bar.

Claw Bars

Although the number of designs of claw bars in current use is not large when compared with track wrenches or lining bars, and is somewhat less than for tamping bars, the designs for this tool exhibit the same minor differences in non-essential dimensions as are found in practically all designs for track materials and tools. There is no track tool, however, for which there has been a greater number of changes in design over a period of years, although one design that is widely used today was developed by the Roadmasters' Association almost 50 years ago, and this design still remains substantially the same as when first approved by that association.

Since there are so many individual dimensions in a claw bar, many of which are closely interrelated, even a small change may have the effect of creating an entirely new design, particularly if it occurs in the claw end. Because of the large number of dimensions which characterize it, this tool is difficult to discuss in detail. Differences occur, however, in the width and depth of the claw opening, in the overall width of the claw, in its length, in the angle it makes with the axis of the shank, in the length and shape of the heel, in the radii which form the outline of the claw, in the length, width and thickness of the neck joining the shank and the claw, in the diameter of the shank, in the overall length of the tool and in the shape of the upper end, which may be either plain or have a chisel point.

These are only the more important dimensions, in addition to which there are numerous others, affording opportunity for an almost unlimited number of combinations, any one of which will create a design that differs from all of the remainder. Although the number of designs in use at one time is not large, generally being about 50, changes in design are frequent. One of the striking features of these changes is that they are usually small and, in most cases, are not of a character that will affect the utility of the tool. Yet this may have results that are not taken into consideration by the designer. The accompanying table of dimensions for 10 designs of claw bars illustrates the wide range covered by many of the individual dimensions and also how minor the differences are between some of the designs. In fact, some of the differences shown in the table are so slight that it is difficult to detect them in the finished tools without applying a template.



A	B	C	D	E	G	G'	H
45	29½	15	12½	1	3	--	⅝
60	32	14	14	1¼	3	3	¾
61	28⅜	15⅝	17	1⅝	4¼	3⅞	9/16
63	31	14	18	1¼	6	3½	¾
63	35	14	14	1¼	3	3	¾
65	32	15	18	1¼	2½	2½	¾
66	37⅝	14⅜	14	1⅜	2⅜	2⅜	11/16
66	38	14	14	1½	3	3	⅞
67	39	14	14	1½	3	3	⅞
72	42	12	18	1⅜	4	4	¾

Variations in Different Designs of Lining Bars—All Dimensions in Inches

As has been pointed out in preceding articles of this series, there are two parties at interest in the design of track tools, the railways and the manufacturers. The railway has two problems to consider, the first of which is purely local, while the other relates to the broad question of economy. The railway's first interest is to obtain tools that will perform satisfactorily the work that is demanded of them at a cost as low as is consistent with this requirement.

Since track tools are not interchanged between roads, but are used solely on the road which purchases them, it is of no importance to any road whether some other road is using the same or different designs of lining, tamping and claw bars, so far as local maintenance problems are involved. In general, the stores department carries a stock of hand tools, but neither diversity nor duplication of design, as between two or more roads, will affect the size of this stock. Furthermore, tools that have been distributed are used until they are worn out, after which they are replaced from the stores department stock, so that even frequent changes in the designs for lining, tamping and claw bars should have no effect on the size of this stock or the total volume of purchases. So far as the local problems of maintenance and supply are concerned, it is of no advantage to a road, therefore, to adopt a design that is used on some other road. Again, so far as these problems are involved, there is no disadvantage in changing designs frequently.

Production Costs

In exploring the broader question of economy, we must turn to the manufacturer and study the effect on him of a multiplicity of designs and of frequent changes in design, and then follow back to determine how this reacts on the railways. In doing this, because of certain differences inherent in the manufacture of the individual tools, it will be necessary to discuss lining bars, tamping bars and claw bars separately.

One of the problems of the manufacturer in connection with lining bars is the size of the stock of raw material he must carry. As has been pointed out, the square dimension of lining bars ranges from 1 to 1¾ in. by increments of ⅛ in., making seven

sizes of bar stock necessary. In general, the analysis of the metal is substantially the same for all designs, although some roads require special steels, thus increasing the stock.

The cost of dies for lining bars is not as large as for other tools, since different sizes (weights) of the same design can be made on a single die. However, a separate die is required for each type of point, the forging of the point being a separate operation from the forming of the remainder of the tool. For this reason, the manufacturer must not only maintain a large stock of raw material but is prevented from making up a stock of finished tools in advance. Certain manufacturers have been successful in persuading some of their customers whose designs vary only slightly from those of the A.R.E.A., to accept the latter in lieu of their own, and in this way have made it possible to build up a stock of partly-finished tools of this design in advance, and forge the proper point when the order is received.

The Dies

Dies for drop-hammer machines cost about $200 each, and separate dies must be provided for designs which differ in major particulars, although small differences can be taken care of without changing dies. This change costs about $7.50, exclusive of the production lost while the change is being made. Press dies cost about $85 a set and a change of such dies costs $30. Dies can be dressed about six times before they must be discarded. A special template must be provided for the operator for each design of lining bar.

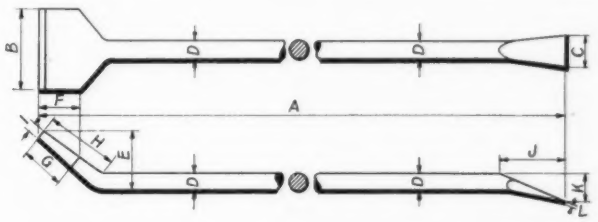
Individual dies are required for each design of chisel, grab or spear point for tamping bars, although several sizes of tamping blade can be made on a single die. The cost of dies, and of changing them, for hammer machines is approximately the same as for lining bars. A set of press dies for tamping bars costs from $175 to $200, depending on the design, and it costs $30 to change dies.

Despite the relatively small number of designs for claw bars that are in use at any one time, there is no tool that causes the manufacturer more trouble with respect to both manufacture and frequent changes in design, even in the face of the fact that the bulk of the production is confined to three designs, these being the standard adopted many years ago by the Roadmasters' Association, the A.R.E.A. design and the gooseneck type.

Every change in the design of the claw, no matter how slight, requires a different die, which costs about $300 for the forging machines. Separate dies are also required for each design of the chisel end and for forming the shank. For press work, 14 dies are necessary, at a total cost of about $200, and, in addition, the shank is formed by a separate die in a forging machine. The cost of changing dies is about the same as for those used in shaping lining and tamping bars.

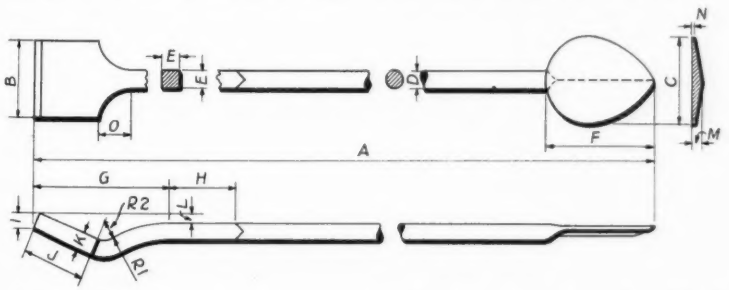
Manufacturers are able to make up in advance a stock of the three designs of claw bars, which represent about 80 per cent of their production. A manufacturer is not warranted in making up a stock of any of the remaining 47 designs, however, because any of them may be changed without notice, or the road may, without warning, place its orders with another manufacturer. In either event, he is left with the stock on his hands and, from a sales standpoint, nothing is more useless than an obsolete claw bar.

It is evident that costs of production are increased materially by the multiplicity of designs for lining, tamping and claw bars, and by frequent changes in these designs, which require the manufacturer to maintain a large stock of costly dies, many of which become obsolete before they can be amortized, and to make frequent changes in the setting of the dies in the machines on which they are produced. These costs are still further increased by reason of inability to make up stocks in advance, except as noted, so that shop operations become largely seasonal. The manufacturer is thus prevented from taking advantage of the dull season to provide stocks from which he can draw during the busy season when many roads are sending in orders.



A	B	C	D	E	F	G	H	I	J	K	L	
60	3½	.....	⅞	3¼	3	3	4½	⅞	.....	.....	.....	Plain round end
61	3⅜	2⅜	1	3⅜	3⅞	2⅛	4⅜	11/16	4¼	1-9/16	5/32	
61	4	1½	⅞	3	2¼	2⅜	3⅜	½	3½	1½	⅛	
61	4	2	⅞	3	2¼	.....	3¾	½	3	.....	0	Chisel end straight
64¾	4	2	⅞	2½	2¼	2¼	3¾	⅜	3½	.....	3/32	Chisel end straight
65	3⅝	.....	1	3-3/16	3⅜	.....	4¼	1	.....	.....	.....	Plain round end
66	3½	2⅞	⅞	2-5/16	4	.....	5¼	⅜	7⅝	1-13/16	⅛	
72	4	.....	⅞	2½	.....	2½	4	½	.....	.....	.....	Tamping blades on both ends

Chisel-End Tamping Bars—Dimensions in Inches



A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	R1	R2
66	3⅜	4⅝	⅜	....	6¾	7½	....	⅜	3½	¾	½	½	⅜	....	6	1
66	4	4½	⅞	⅜	6	7½	4	13/16	3½	⅞	½	½	⅜	1¾	6	1
68	4	4¾	1	....	7½	6	4½	½	3¼	¾	⅜	11/16	5/32	....	5½	¾
68	4	4¾	1	1	6⅞	5⅛	5	....	3¼	1	2¼	9/16	3/16	2	6½	1⅛

Spear-End Tamping Bars—Dimensions in Inches

An Example

An excellent example of the multiplicity of designs and of minor differences in non-essential details is given in the two illustrations, one of 15 claw bars and the other of 12 lining bars, of tools that were being made in a single plant on the day that the photographs were taken. No two of these claw bars are of the same length and only two of the lining bars are, although in both cases a number of these differences are less than the usual tolerance.

Without using a template, it would be difficult to distinguish between sev-

eral of the designs of lining bars shown in the illustration. Even where there is considerable difference in the overall length, one would need to be a keen observer to detect most of the differences between several of the designs if the bars are examined separately.

Claw bars, as shown in the illustration, provide an interesting study in design. While it would be tedious to point out all of the differences, attention is called to the marked dissimilarity of the claw ends; yet it would require but a few minor changes in dimensions to bring several of them to substantially the same pattern. Likewise, no two of the chisel ends are alike, yet the differences between several of them are almost negligible. On the other hand, three of these tools have plain round ends and one is finished with a bulb end.

In view of the great multiplicity of designs for lining bars and of the many differences that exist in the designs for tamping bars and in those for claw bars, it seems proper to inquire whether, out of all of this confusion, designs for the several tools can be standardized. In lining bars, preferences with respect to total length are well established, so that it would be difficult to obtain agreement on a single length. Yet there is no evidence that a lining bar 65 in. long is either more or less effective or easier to handle than one that is 63 in. long or another that measures 68 in. For this reason, there should be no obstacle in settling on three or four lengths between, say, 54 in. and 72 in., with a minimum difference of 6 in. between the several lengths.

Other Possibilities

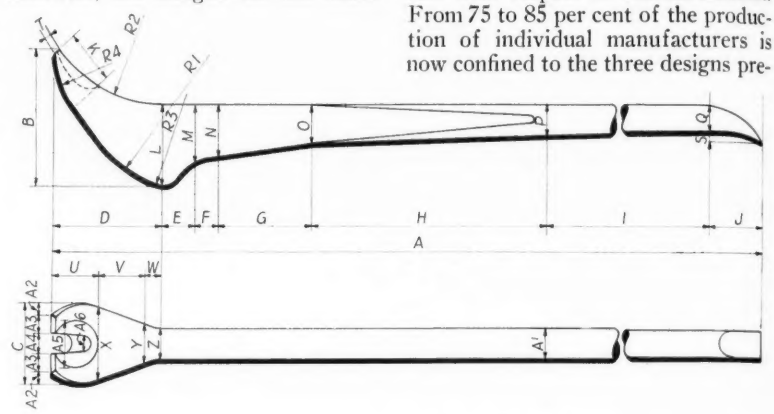
In the same way it should be possible to reduce the square dimension of the stock to not more than three sizes, while dimensions C and D could be brought to a rigid standard without in any way impairing the utility of the tool. Preferences with respect to the point are also well established, and there should be no objection to retaining the four types of point in two or three lengths. Action along these lines, while greatly simplifying the manufacturer's problem, would still provide ample latitude for the roads to select designs which will fully meet their needs. In addition, it will point the way to still greater simplification as the benefits of a reduction in the number of designs becomes appreciated.

Many maintenance officers are convinced that different types of ballast require different designs of tamping blades for tamping bars. There is no evidence, however, that the many small differences that are found in the designs for this tool add to its utility. If the minor differences could be compromised, the number of designs for the blade could be reduced to possibly four or five basic forms. Likewise, the designs for the chisel and spear ends could be reduced to, say, two for each type. At present only two sizes of stock are required for making this tool and these could be retained, at the same time eliminating the octagonal shank which is required by only a few designs.

Attention has been called to the fact that, in most cases, the bulk of the production of any article is confined to a few designs. This does not hold true for either lining bars or tamping bars, since there is no design, or group of designs, for either of these tools which predominates. Although the A.R.E.A. designs are more widely used than any other, they account for only a small part of the total production, since most of the roads prefer their own designs for these tools.

Claw bars afford a different problem with respect to standardization. From 75 to 85 per cent of the production of individual manufacturers is now confined to the three designs previously mentioned, while approximately 47 designs account for the remaining 15 to 25 per cent. Obviously, it is in this large number of designs, which represent so small a part of the total production, that the frequent changes in design occur, which so materially increase the cost of producing claw bars. In view of the fact that these three designs are satisfactory to the preponderant majority of the roads, it seems reasonable to believe that they afford sufficient lati-

(Continued on page 242)



A	54	56½	58	60	60	60	60	60	62	66
B	2¾	5½	6⅜	4¼	5	5⅝	5¾	6⅛	4⅞	6
C	2¾	2¾	3⅛	2⅝	3	3¼	2¾	2¾	2⅝	3
D	.....	5½	4⅜	4¾	4½	4⅝	6	6-3/16	5½	5⅜
E	.....	2½	1¼	.....	⅞	1⅜	.....	.....	.....	1⅝
F	.....	5½	4	.....	.....	1	.....	.....	.....	.....
G	.....	.....	10	.....	6⅛	4	.....	.....	.....	.....
H	.....	.....	36⅛	.....	7	10	6	15	.....	.....
I	.....	33½	.....	43	39	36½	39½	23	.....	41½
J	.....	2½	2½	8	2½	2½	2½	4	2¾	2½
K	.....	2¼	1¾	1½	.....	2¼	2	1⅞	1⅝	.....
L	.....	2-15/32	3⅜	1⅜	2⅝	3⅜	2⅞	2⅞	.....	3¾
M	.....	2-1/16	1⅞	.....	2¼	2⅜	.....	.....	.....	2⅜
N	.....	1¾	1⅞	.....	.....	2⅛	.....	1¾	.....	.....
O	1½	.....	.....	1⅜	1¾	1⅝	1⅞	.....	1-9/16	.....
P	.....	1⅜	1¼	1¼	1½	1¼	1⅜	1¼	1-5/16	1¼
Q	¾	1	1	1¼	1⅜	1	1¼	1¼	1¼	1
R1	3	9¾	20	4¼	6½	10	6⅜	7-15/16	.....	.....
R2	6	6¾	5½	2⅞	9	5½	7¼	9	.....	.....
R3	.....	.....	.....	.....	.....	4½	4¾	1¾	.....	.....
R4	.....	3¾	10	.....	.....	3	6⅜	17¼	.....	.....
S	.....	1⅜	¼	1	½	½	½	½	11/16	¼
T	.....	3/16	¼	.....	.....	¼	.....	¼	¼	¼
U	2½	.....	1⅞	.....	1¾	2	.....	.....	.....	.....
V	.....	.....	.....	.....	.....	2	.....	.....	.....	.....
W	.....	.....	.....	.....	⅞	⅝	.....	.....	.....	.....
X	.....	2¼	2½	.....	.....	2⅞	2¾	2¾	.....	.....
Y	.....	1¼	1¾	.....	.....	1⅝	.....	.....	1-9/16	.....
Z	1½	1¼	1¼	1⅜	1¼	1¼	1¼	1¼	.....	1¼
A1	.....	1⅜	1¼	⅞	1⅜	1¼	1¼	1¼	1-5/16	1¼
A2	.....	1	27/32	.....	.....	½	.....	.....	3/16	5/16
A3	.....	15/32	5/16	.....	.....	11/16	.....	.....	23/32	¾
A4	⅞	13/16	13/16	11/16	13/16	⅞	⅞	⅞	13/16	⅞
A5	1⅛	2⅛	1⅝	.....	.....	1⅞	1½	1¾	1⅝	.....
A6	⅜	⅝	⅝	.....	⅝	13/16	½	¾	⅝	¾

Variations in the Design of Claw Bars—Dimensions in Inches

A Surface Grinder in Operation

The Flatter Is Being Replaced by the Grinder

Flatter vs. Grinder In Gas Rail Welding*

By G. M. O'ROURKE,

District Engineer, Illinois Central, Chicago

In 1931, after ten years' use of the flatter for finishing rail ends built up by the oxy-acetylene process, the Illinois Central purchased a combination surface and cross grinder for use in connection with the rail welding work. In this article Mr. O'Rourke outlines his experience with the grinder and gives the results of time studies made to determine the relative costs of the grinder and flatter methods of finishing rail welds.

SINCE starting rail end welding in 1921, the Illinois Central has reconditioned more than 1,000,000 joints. The cost of doing this work has steadily decreased from year to year throughout this period. In addition to this reconditioning of rail ends, the oxy-acetylene process has been used in the building up of worn frogs and crossings, the butt welding of rails to make one long continuous rail through street crossings, the construction of steel cross ties from scrap rails for use where locomotive fire boxes are cleaned and hot cinders are dumped, the reclaiming of broken switch stands and other track appliances and tools, and for a multitude of operations in motor car repair shops.

The most extensive use of the oxy-acetylene welding process in maintenance of way work on the Illinois Central, however, has been in the reconditioning of rail ends, or the building up of the joints, in track. To carry on such work successfully, one should have a comprehensive plan, and keep in touch with its progress just as is done with other maintenance work, such as the laying of new rail, the application of ties and ballast, surfacing, etc., and be most careful to secure quality workmanship rather than to place too much stress on the cost per joint.

The process of building up rail ends during the first decade consisted of first chipping out and roughing the damaged part of the old or battered rail, and then building up the rail end to its original height by heating the welding rod until a sufficient amount of steel was welded to the top of the rail head. The surface of the weld was finished by pounding it over the top and sides with what is known as the flatter, then a V-shaped notch was provided at the junction of the rails by means of a chisel. No grinding was done at this time, either on top of or at the ends of the rails.

Started in 1931

During the early part of 1931, we purchased a combination surface and cross grinder for use in connection with the building up of rail ends by the oxy-acetylene process. For a time after this unit was put in service, the expense of the work per joint increased. However, as we have become more familiar with its use, we have gradually reduced this expense. This grinder was used with a gang of five men and a working foreman. After it was in service for a while, time studies were made to compare the cost of rail end welding, finished by the grinder and flatter methods. Some cost figures showing the results of these studies are submitted herewith, in all of which charges covering interest, depreciation and maintenance of the equipment have been included.

The item of grinding in connection with rail welds is of major importance from a cost standpoint. In support of this, some figures are included on the comparative cost of finishing rail joint welds, on an inch basis.

The items comprising the direct costs shown in the table include the labor charge for the welders and welder helpers actually doing the work, together with the cost of the material necessary for building up the joints. The indirect costs include the pay of the foreman, if not working, and the pay of the welders and helpers for such time as they were not actually employed on the joints. Where the grinder was used, there is also included the cost of gasoline, oil and grinding wheels, in addition to a

*Abstract of a paper presented before the thirty-fifth annual meeting of the International Acetylene Association, at Pittsburgh, Pa.

charge of approximately 1.3 cents per joint for ownership and maintenance of the machine.

We are convinced that, under general conditions, we are saving 20 cents per joint by the use of the grinder, when we are using the proper organization. As a result of the savings made by the use of the first grinder purchased in 1931, we purchased several more.

Gang Organization

The various gang organizations employed in oxy-acetylene rail end welding on the Illinois Central since work of this nature was started, are as follows:

Three-man gang:
- Two welders
- One helper
- All finishing done with flatters and ends beveled with a chisel.
- Helper acts as flagman, assists in the moving of the tanks and equipment, and oils the joints after welding is completed.

Six-man gang:
- One lead welder
- Three welders
- Two helpers
- Lead welder marks the joints to be welded and supervises the work of the other welders and grinders. The amount of batter is measured with a straight edge and a taper gage, and the limits of the weld are marked on the side of the ball and the rail.

Seven-man gang:
- One lead welder
- Three welders
- One welder helper
- One grinding machine operator
- One grinder helper

Eight-man gang:
- One lead welder
- Three welders
- Two helpers
- Two laborers
- This organization adapted where traffic is heavy and the vision is poor.
- One laborer acts as a watchman for the welders and assists in moving.
- The other laborer acts as a watchman for the grinder operators and oils the joints after the welds are completed.

Another eight-man gang
- One working welding foreman, or lead welder
- Five welders
- Two helpers operating grinder
- (Note)—Section gang distributes tanks and raises the joints ahead of this gang.

Nine-man gang:
- Combination smoothing and welding gang
- One extra-gang foreman
- Four welders
- Two helpers
- Two laborers
- Extra gang foreman supervises raising of joints ahead of the welders, marks joints to be built up, and sees that the gas tanks are picked up and distributed to avoid loss of welding time. Helpers operate the grinding machine. Laborers raise joints and tighten bolts ahead of the work and oil the joints following welding, as well as all moving work.

Eleven-man gang:
- One lead welder
- Seven welders
- Two helpers
- One laborer

The gang organization employed depends upon local conditions, including the condition of the rail being welded, whether in single or double-track territory, whether the track is straight, with an unobstructed view, or in deep cuts with many curves, and the amount of traffic. The length of the welds largely governs the progress made. Welds in double-track territory are longer on the receiving end than on the leaving end, and the full length of welds in double track is rarely as long as the welds in single track, even though the rail is of the same age and the traffic no heavier. We have found that, because of chipping or battering, it is necessary to build up rail ends in from 4 to 10 years after the rail is laid new, depending largely upon the weight of the rail and the amount of traffic over it.

Using a Cross Grinder

Our welding gangs are equipped with outfit cars, motor cars with the required number of trailers, and mono-rail cars for moving cylinders and supplies. The outfit cars are moved from station to station nearest the point of work being done.

Full cylinders are spotted five rail lengths apart (39-ft. rails), thereby allowing each welder ten joints to build up before it is necessary for him to move ahead to the next setting. The welding outfits are equipped with 100 ft. of hose, in preference to 50 ft., since the longer length reduces the time required of the welders in moving from one setting to another. This is quite important in the case of gangs that are equipped with a grinding machine.

Must Be Planned

To obtain the economies which are possible by finishing rail end welds with a surface grinder, as compared with the flatter method, it is necessary to maintain the production of the welders to the limit of the capacity of the grinding machine. A comparison of the production of welders and grinders indicates that it is possible for each grinding machine to finish the present output of as many as eight welders. With individual welder production at the maximum, each surface grinder can finish the work of six average welders. Careful planning is necessary to reduce the number of moves and the loss of time for any reason other than that of traffic. Individual welder's production must be maintained at the highest possible level, without sacrificing quality. The application of weld metal should be carefully checked and the amount of metal applied should be kept within the closest possible limits for finishing up with the grinders. A reduction in the cost of building up rail ends of 20 to 30 percent below that existing generally can be obtained by careful supervision and planning, and by further education of the welders in the economical use of welding materials.

Use of the surface grinding ma-

Cost of Rail End Welds With Flatter and Grinder Finish

Grinder		Flatter	
Length of batter	Average cost per joint	Length of batter	Average cost per joint
5.77 in.	$.73	5.18 in.	$1.11
		6.16 in.	1.10
10.47 in.	1.51	9.30 in.	1.57
13.13 in.	1.96	12.17 in.	2.06

Cost of Finishing Welds—Grinder and Flatter Methods

	Grinder Finish			Flatter Finish		
Length of joint	Direct Cost	Indirect Cost	Total	Direct Cost	Indirect Cost	Total
3 in.	$0.394	$0.039	$0.433	$0.647	$0.129	$0.776
6 in.	0.639	0.064	0.703	0.929	0.186	1.115
9 in.	1.232	0.123	1.355	1.234	0.247	1.481
12 in.	1.492	0.149	1.641	2.212	0.442	2.654

chine overcomes a tendency among some road supervisors to crown the joints too high, which is wrong since the welds are harder than the adjacent metal in the head and, if too high, cause batter on each side on single track, and on the receiving rails of double track. We have had very little trouble with batter occurring back of the welds.

The grinding wheels used in the grinding work should be tipped or shaped to give to the welded surface the same contour as that of the head adjacent to the weld—that is, to fit the coming of the wheels of locomotives and cars. If the grinding wheels chatter on the hard weld surface or if slight depressions occur in grinding, traffic will make the rail batter or cup again, the same as before welding, but likely in a different location.

Extent of Hardening

Our 110-lb. A.R.E.A. rail has a carbon content of 0.67 to 0.80, and a Brinell hardness, before laying, of from 245 to 255. After the rail has been subject to cold rolling under traffic for a period of some weeks, the Brinell rises from 260 to 270. Rail ends which have been built up by the oxy-acetylene process, as we use it, show a hardness of from 300 to 325 Brinell immediately after welding. After several weeks of cold rolling, the Brinell will rise to from 325 to 350.

We are putting a slight bevel on our repaired rail ends during the cross cutting operation. This bevel should not be more than ¼ in. deep, and the additional opening occasioned by the bevel should not be more than ⅛ in.

We consider the results obtained from building up rail ends to be very satisfactory, and we have no doubt at all but that the practice is justified. However, the effect is considerably nullified unless something can be done to prevent slap batter due to loss of metal on the underside of the ball of the rail and on top of the angle bars. This problem has not yet been solved. Reformed, crowned bars, or shims placed on top of the angle bars, or between the base and the bar, have been used on the Illinois Central. They pull up the drooped rail ends and thereby reduce the amount of welding required. One manufacturer of rail joints has a bar on the market which is also said to accomplish this.

Are You Proud of Your Road?*

By C. W. Engle
Assistant Division Engineer,
Cleveland, Cincinnati, Chicago & St. Louis

PRIDE of ownership is an inherent characteristic in every individual. It is reflected in the attitude of children toward their small possessions, and in older persons toward everything that they own or love. Because of their pride of ownership, individuals take great pleasure in protecting, caring for and pleasing those persons, things or organizations that they are in the habit of referring to as their own.

So it is on the railroad. No doubt you remember the first morning you started to work for the railroad. The foreman handed you a shovel, saying it was yours. You knew of course, that the railroad bought and paid for that shovel and was the real owner, but nevertheless when it was handed to you it became "yours." You put your mark of identification on the handle and, until it was worn out, you preferred to use it in preference to any other shovel and even objected to your fellow-workers borrowing it. There were other tools which you also claimed as yours, for example, a spike maul that seemed to fit your hands and your swing better than any other.

Later you developed a certain pride in your gang, which increased as time went on. You called it "our gang," and were certain that it was the best gang on the railroad—again that pride of ownership.

Then came a day when your supervisor called you to one side and told you he had decided to give you one of his gangs. I wish to emphasize his expression in saying that he would give you one of *his* gangs. The supervisor chose to give you a promotion because he felt that you would take pride in "owning" a gang. Immediately on assuming control of the gang you became the "owner" of each of the men. You called it "my gang" instead of "our gang." We all know that in this country no man is owned by another, but as you became better acquainted with your men you began to regard them as members of your railroad family; you felt responsible for their health, for their workmanship and for their welfare—all evidence of your pride of ownership.

As time went on your pride of ownership constantly increased. Your pride in the condition of that piece of track, in that bridge, in those signals, and in that interlocking plant became greater until today, as foreman with years of service to your credit, you have acquired a feeling of ownership for that portion of the property which the company has assigned to your care.

In Maintenance Department

In the maintenance of way department, individuals are in closer contact with materials and tools than the men in other departments. The car repairman works on the car of one railroad today and the car of another railroad tomorrow, and the car of some other foreign line on the following day. The fact that he feels that he will never see those cars again is not conducive to the creation of the same pride of ownership that the maintenance of way man develops when he sees the same piece of track, and the same bridges, signals, etc., every day. In these days when enginemen operate one locomotive today and another tomorrow, they do not have the same pride of ownership that was theirs when a locomotive was assigned to each man.

In these days of reduced allotments of materials and labor, the pride of ownership that maintenance of way men have toward their railroads must be given its share of credit for the splendid record that has been made in the maintenance of track and structures in recent years.

*Abstract of an address presented before the annual convention of the Association of Maintenance of Way Foremen of the Big Four at Cincinnati, Ohio.

View of the Nenana River Bridge of the Alaska Railroad

Preframing Proves Practical

By L. G. BYRD

Bridge and Building Supervisor, Missouri Pacific, Poplar Bluff, Mo.

The Missouri Pacific has used 5,000,000 ft. b.m. of treated timber so prepared in the construction of pile trestles since 1929. In this article the author describes some of the practices developed in the work on his road.

THE advantages of preframing bridge timbers before treatment are now generally recognized, although some bridge men still question the practicability of preframing successfully all of the pieces used in the construction of open-deck and ballast-deck trestles. The Missouri Pacific, however, has been so successful in the preframing of all members of trestles, except the piles, that standard framing plans have now been prepared, covering the caps, stringers, ties, guard timbers, braces and backwalls for open-deck trestles. For ballast-deck trestles the plans cover, in addition, the ballast retainers and spacing blocks. Standard plans providing for 12-ft., 13-ft. and 14-ft. panel lengths for both types of structures have been prepared. Incidentally, the practice of preframing has also been extended to include timbers for station platforms.

Progress Made

Since 1929, when the practice of preframing was inaugurated on the Missouri Pacific, more than 5,000,000 ft. b. m. of preframed bridge timbers have been treated. These timbers have been used in the construction of 7,088 lin. ft. of open-deck trestles and about 4,000 lin. ft. of ballast-deck trestles. The structures involved have ranged from 3 to 190 panels in length, and in each case the preframing and preboring, as well as the spacing of the pile bents, were done so accurately that the occasions for changing the framing or for reaming or boring holes in the field have been rare. In fact, in the construction of 9,088 lin. ft. of trestles, ranging from 3 ft. to 36 ft. in height it was necessary to rebore less than 10 holes.

The successful preframing of timbers for long trestles naturally requires a high degree of accuracy in preparing the timbers and in laying out the bents on the ground. Our most difficult problem has been the development of a sufficiently accurate method for spacing the bents for pile trestles ranging from 1,500 to 2,000 ft. in length. Our usual practice is to use a steel tape to measure off the panel lengths along both outside guard timbers of the structure to be renewed, indicating the center line of each bent with a finely pointed scratch awl and driving nails in the guard timbers as markers. The piles are then located with a plumb bob and stakes driven to mark their locations.

All bridge material is preframed and treated at the treating plant at North Little Rock, Ark., where the work is so organized as to require the minimum of handling of the timbers. All holes are bored by power drills, those in the caps and stringers being bored half way through from each side with a $1\frac{3}{16}$-in. auger. When a pile trestle is to be renewed, requisitions for the necessary preframed material are forwarded to the stores department, which instructs the treating plant as to the material needed and the location where it is to be used.

Our preframing practices may best be explained by a description of the pile trestle approach at the north end of the through truss span across the White River between Lexa, Ark., and McGehee, which involved one of the first important applications of preframing on the Missouri Pacific. This approach comprised forty-five 12-ft. panels and was of open-deck construction with three-ply stringers and six-pile bents. It had barely been completed before it was entirely destroyed by fire in February, 1930, the piles being consumed down to the surface of the water. The structure that was constructed to replace the burned bridge comprised framed bents carried on the old pile stubs, and was also preframed throughout.

The First Work

The original preframed pile trestle installed at this crossing had 14-in. by 14-in. by 14-ft. caps which were attached to the piles by 2-in. by 3-in. by $\frac{3}{8}$-in. angles 18 in. long. There were four such angles to each bent, one to each of the four inside piles on alternate sides of the cap. The angles were drilled with two $1\frac{3}{16}$-in. holes on 11-in. centers and were bolted to the cap and the piles with $\frac{3}{4}$-in. by 16-in. bolts. The outside piles of the bents were held in place by the sway bracing, which was also bolted to the cap. This construction required the boring of 11 holes in each cap.

The Timbers in this Frame Trestle Were Preframed

All caps were of the same size and identically framed except that for the end bent where, owing to the absence of sway braces, six angle irons secure the cap to the piles.

The stringers in this structure were 8-in. by 16-in. members, two panels long, with the joints alternating. Eight holes were bored in each piece, 2 at each end and 4 in the center, to accommodate ¾-in. by 31-in. chord bolts, with ¾-in. by 2-in. cast iron packing spools between adjacent stringers. The chords were anchored to each cap by means of a 4-in. by 4-in. angle 22½ in. long, which was attached to the outside stringer by means of the packing bolts and to the cap by two ¾-in. by 16-in. bolts on 6-in. centers. All stringers except those to be used in the end panels, which required a different spacing for the bolt holes, were identical as to length and framing and therefore interchangeable. The anchoring of the stringers and caps by the method described above has a distinct advantage as compared with the use of drift bolts in that the labor cost of renewing the caps and stringers is much less.

The preframing of the ties involved the boring of holes for spikes for holding the running rails and the inside guard rails as well as holes for ¾-in. log screws for attaching the outside timber guard rails to the ties. According to the present standards, the preframing of ties requires the boring of from 20 to 23 holes in each tie, the larger number of holes being required in ties for use in overflow districts where anchor bolts and boat spikes are required to maintain the track in line. The guard timbers, which were 4-in. by 8-in. in section and 18 ft. to 24 ft. long, were bored for ¾-in. lag screws on 12-in. centers, staggered.

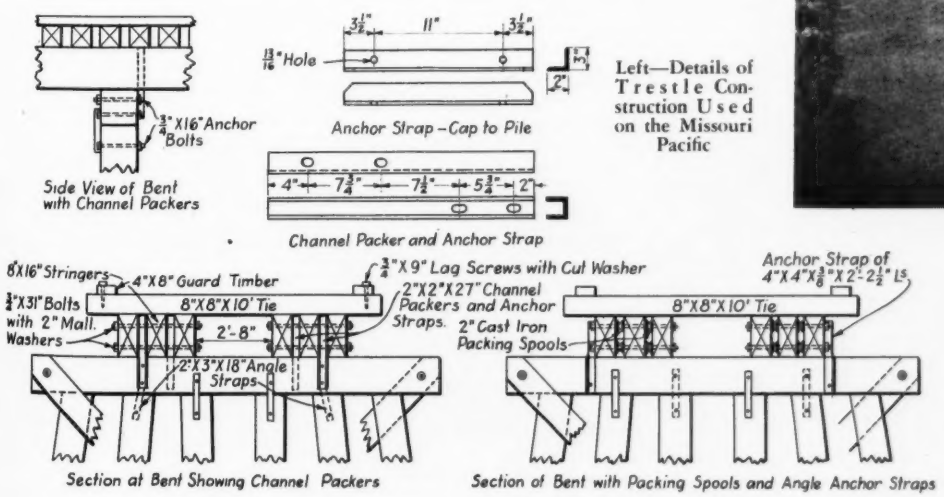
Fire protection for the caps in this structure consisted of two strips of 20-gage galvanized iron, 18-in. wide by 90-in. long, to each cap, the edges of which were bent down over the sides and ends of the cap at an angle of 45 deg., and fastened with obsolete dating nails. Similar protection was provided for the stringers.

Entirely Preframed

The frame-bent structure with which this bridge was replaced following its destruction by fire, was also entirely preframed. In this structure the bents were supported on the pile stubs of the old bents, the anchorage consisting of ⅜-in. by 3-in. by 44-in. iron straps bolted to the pile stubs and to the sills and posts of the new bents. The cutoff of the piles was 26 ft. below the base of rail and, with the exception of the dump bents, all bents were of the same height.

All material for this structure was assembled at the treating plant at North Little Rock, where it was preframed by the division bridge and building gang. The material was then shipped to the site of the bridge, where the bents were bolted together and set in place by a hoisting machine. It was not necessary to rebore any of the holes.

What is regarded as a more desirable method of attaching the stringers to the caps than that used in connection with the first structure described, has been employed on other preframed bridges. This method does away with packing spools by utilizing 2-in. by 2-in. by ⅜-in. channels, 27 in. long, which are inserted between the stringers on alternate sides of the cap and bolted to the cap to serve both as spacers and as anchorage for the stringers, the chord bolts being inserted through holes drilled in the legs of the channels.



Left—Details of Trestle Construction Used on the Missouri Pacific

8"X16" Stringers
4"X8" Guard Timber
¾"X31" Bolts with 2" Mall. Washers
8"X8"X10' Tie
2'-8"
2"X3"X18" Angle Straps
Section at Bent Showing Channel Packers
¾"X9" Lag Screws with Cut Washer
2"X2"X27" Channel Packers and Anchor Straps.
2" Cast Iron Packing Spools
Anchor Strap of 4"X4"X⅜"X2'-2½" LS
8"X8"X10' Tie
Section of Bent with Packing Spools and Angle Anchor Straps

The Pile and Frame Trestles Shown Above Are Examples of Preframed structures.

Roofs

How Dutch-lap Asbestos Shingles Are Laid

IN TWO previous articles, the new manual of roofing practices which has been prepared by the Northern Pacific was described, and the instructions for applying hexagonal asbestos shingles were given. The present article continues the rules for applying asbestos shingles, dealing, however, with the Dutch-lap design; with the application of both designs over old wood shingles; and with maintenance. The instructions for applying Dutch-lap shingles directly to the roof deck follow:

Before applying Dutch-lap shingles, cover the roof surface with saturated felt in the manner described for the hexagonal design.

Shingles of this type must be aligned on the shingle-nail and storm-anchor holes, paying no attention to the contact or lack of contact between the side edges of the shingles in adjacent courses. The storm-anchor holes and certain nail holes must register, as will be described in detail later.

The different shapes of the shingles used in this method are eaves starters and main-body shingles, these being shown in one of the illustrations.

Application of shingles of this type shall be started at the end of the roof farthest removed from the direction from which the most severe storms come. The reason for this becomes evident when it is understood that, as applied, these shingles overlap each other at the side and that, therefore, one side edge is entirely exposed.

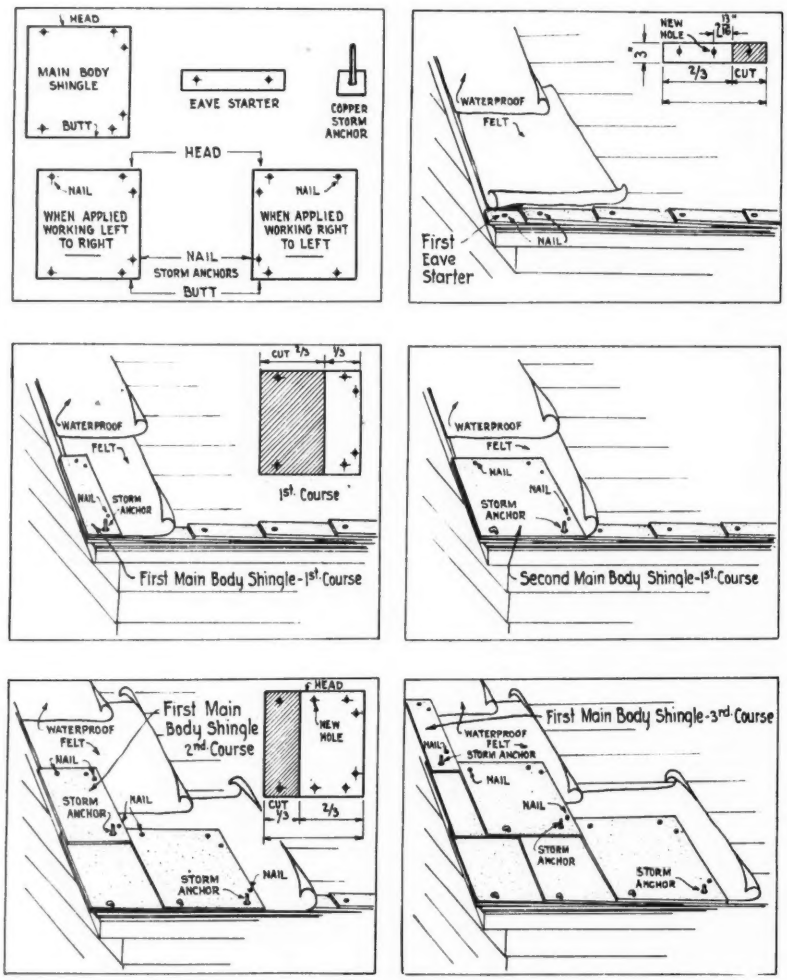
The Method

Five sketches have been prepared, showing the progressive steps for applying these shingles when working from left to right. To work from right to left, the entire operation is reversed, the eaves starters and the body shingles being reversed, turning them end for end, to bring the nail holes adjoining one side edge to the left instead of to the right. A shingle reversed is shown in one of the drawings.

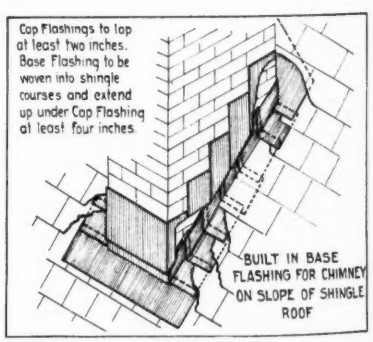
Before applying the eaves starters, the saturated felt along the eaves shall be raised and then placed over the starters after they have been applied.

Eaves starters shall be applied to overhang the eaves and the gables one inch, with their long dimension paralleling the eaves. Each unit shall be laid to lap the preceding one approximately one-third of its length, so that the nail holes will register.

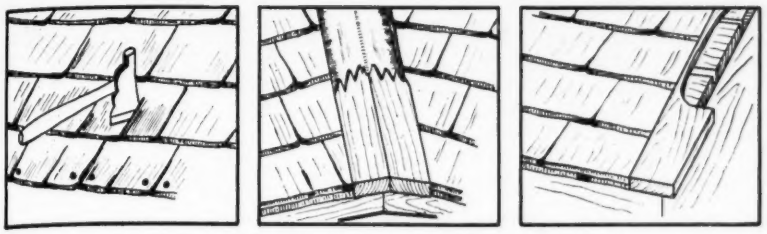
Starting at the end of the roof, apply an eaves starter which has been cut to two-thirds of its original length, and with a new hole drilled 2-13/16 in. from the cut end, as shown. Fasten



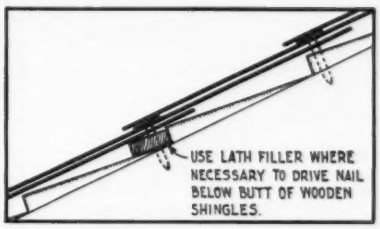
Sequence to Be Followed in Applying Dutch-Lap Shingles


Cap Flashings to lap at least two inches. Base Flashing to be woven into shingle courses and extend up under Cap Flashing at least four inches.
BUILT IN BASE FLASHING FOR CHIMNEY ON SLOPE OF SHINGLE ROOF

Method of Flashing Around Chimneys



All Warped Wood Shingles Shall Be Split and Nailed Flat



Asbestos Shingles Over Wood Shingles

this with a nail driven through the hole nearest the starting end. Overlapping this first piece one-half of its length, apply a full-length eaves starter. Fasten this with a nail driven through the hole which registers with the hole drilled in the preceding eaves starter. Proceed in like manner to the opposite end of the roof, fastening each piece with a nail which shall pass through the holes in both the overlaid and underlying pieces. The final unit to be applied shall be cut as necessary to give it an overhang of one inch.

Body shingles shall be applied to cover completely the eaves starters, providing the same one-inch overhang at both eaves and gables. These shingles are provided with six holes so that they are reversible, end for end, permitting them to be applied either from right to left or left to right without drilling additional holes. It will be noted, by reference to the drawings, that five of these six holes are used, three for shingle nails and two for storm anchors.

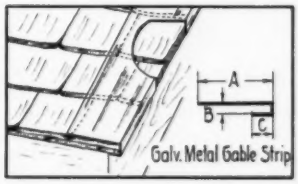
Secured in Place

Each shingle shall be secured with two nails and one storm anchor. New holes shall be drilled in cut shingles as required. Each shingle shall be applied to lap the preceding shingle along its side edge one-third of its width, and so that the nail and storm-anchor holes will register. The shingles of each course shall overlap those of the preceding course three inches.

When starting with the body shingles, apply at the end of the roof a shingle that has been cut to one-third of its original width, as shown on the drawing. Before it is laid, insert a storm anchor in the hole provided for this purpose and fasten the shingle with a nail driven through the hole adjacent to the side edge near the bottom. Completely overlapping this first shingle, apply one of full size, with one storm-anchor hole over the storm anchor which has been inserted in the preceding shingle, and with a storm anchor inserted in the other storm-anchor hole. The next step is to bend down the first storm anchor. When bending storm anchors, press the shingles down firmly into place to insure that the storm anchor will hold the shingle tightly against the underlying shingle. Then fasten the shingle with a nail driven through the hole which registers with the unused hole in the preceding shingle, and with a second nail driven through the hole adjacent to the side edge near the bottom.

Proceed in like manner to the other end of the roof, inserting a storm anchor in each shingle, and placing the shingle with the storm-anchor hole over the storm anchor in the preceding shingle. Bend down this latter storm anchor and fasten the shingle with two nails, one driven through the nail hole which registers with the unused hole in the preceding shingle, the other being driven through the hole adjacent to the side edge near the bottom. The last shingle applied in each course shall be cut as may be necessary to overhang the gable one inch.

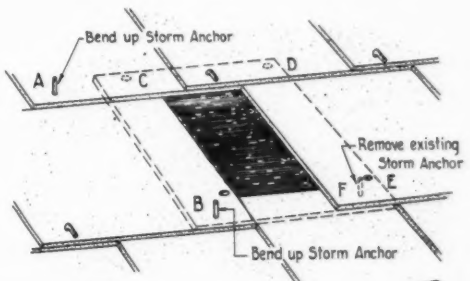
This article, which is the third of a series describing the roofing practices on the Northern Pacific, continues the instructions for applying asbestos shingles. This installment includes the methods for laying the Dutch-lap design directly on the roof deck; both hexagonal and Dutch-lap shingles over old wood shingles; and for the maintenance of both types.



Sheet Metal Gable Strip

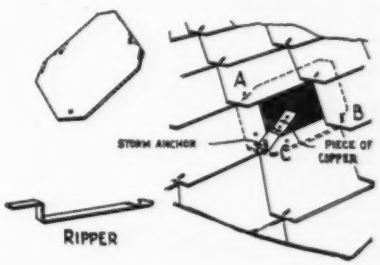
The second course shall be started with a shingle that has been cut to two-thirds of its original width and having a new hole drilling adjoining the head, as shown in the drawing. Insert a storm anchor and fasten as before. This and succeeding shingles shall be applied to overlap the preceding course three inches. The third course shall be started with a shingle cut to one-third width, which shall be overlaid with one of full width, as was done in the first course. The fourth course shall be laid the same as the second course, and so on, alternating in this manner to the ridge, the last shingle on each course being cut to fit the overhang of one inch at the opposite end of the roof.

At the ridges, hips and valleys, the shingles shall be cut and applied as described for the hexagonal method. The ridges and hips shall be finished



Below—Method of Removing and Replacing Broken Hexagonal Shingles

Above—Removing and Replacing Broken Dutch-Lap Shingles



with ridge roll in the manner already described.

As has been mentioned, it has been found feasible on this road to lay rigid asbestos shingles over old wood shingles, and the instructions stipulate that this shall be done wherever possible. The procedure is as follows:

Before applying the asbestos shingles, all badly warped wood shingles shall be split and nailed flat, the method of doing this being shown in one of the illustrations.

Valleys shall be filled to the level of the surface of the wood shingles with boards of the correct thickness, and new valleys shall be applied in accordance with the method to be followed for shingles laid directly on the roof deck. The method of applying the fillers is shown in the illustration.

All chimney and other flashing shall be checked. If not of copper, zinc or lead, or if not in good condition, it shall be replaced with copper in the same manner as if the shingles were to be laid directly on the roof deck.

Remove the wood shingles along the overhanging gables and replace them with boards four inches wide and of the proper thickness to bring the top surface approximately level with the top surface of the wood shingles, as illustrated. If preferred, preformed sheet-metal strips may be used and nailed on 6-in. centers ½ in. from the inner edge, as shown in the drawing. These strips should be made of 24-gage galvanized pure iron and should be painted to match the woodwork. When ordering these strips, give the dimensions A, B, C and the length, as shown in the drawing.

Application

For shingles of either hexagonal or Dutch-lap design, the method of application shall be the same as if laid directly on the roof deck.

Owing to the settlement of the building, an old roof is likely to be out of square. For this reason, when applying hexagonal shingles, it is important to insure that the center line from ridge to eaves be struck at right angles to the eaves line.

At the eaves allow only one-half inch overhang, instead of one inch as is done when applying shingles directly to the roof deck.

If rigid asbestos shingles are applied properly in the first instance, they should require little maintenance, except the replacement of occasional units that may be broken. The methods for making these replacements are described and illustrated.

If the shingles are of the hexagonal design, straighten up the storm anchors as shown in the illustration. Slip the ripper up under the broken shingle and hook it around a nail, then strike the offset of the tool with a hammer until the nail is cut off or drawn. After both nails are cut, place a small piece of sheet copper over the storm anchor at C, as shown, and nail it to the roof. Notch the new shingle, as illustrated, slip it into place and bend down the storm anchor.

To replace Dutch-lap shingles, bend up the storm anchors A and B. Shatter the broken shingle with a hammer blow at the center, and remove the pieces. Next, insert the ripper under the overlying shingle and remove or cut off nails C, D and E. Then insert a new storm anchor in a new shingle. If it has been found impracticable to withdraw the old nails, notch the new shingle at the nail holes, as shown. Slide the new shingle into place over the storm anchor at B, raising the overlying shingle to allow the insertion at F of the new storm anchor in the new shingle. Finally bend down the storm anchors at A, B and F, which completes the operation.

The next article will describe the methods outlined for applying and maintaining asphalt shingles.

Treating Ties With Z.M.A.

After making test installations in 1930 the Great Northern began a broader use of this preservative and of zinc chloride in 1932.

ZINC meta-arsenite as a preservative for cross ties was first considered on the Great Northern in 1930, and in that year two test installations of Z.M.A.-treated ties were installed. For these installations, 1,800 ties were treated with Z.M.A. alone, while 18,000 were treated by a two-movement process, that is, with Z.M.A. first and then with petroleum immediately afterward, the oil being used for the purpose of waterproofing the ties to prevent checking.

The ties used in this test consisted of Inland Empire Douglas fir and western larch. In order to ascertain the action of the ties under varying conditions, the two installations were made in locations where the climatic conditions were of opposite extremes. One installation was made between Spokane, Wash., and Wenatchee, where it is extremely hot and dry during the summer months, with practically no rainfall, a condition that ordinarily leads to considerable checking of ties that have been treated with a salt solution. The other installation is located west of the Cascade mountains in a region of heavy rainfall, where checking is reduced to a minimum. It is still somewhat early to draw conclusions concerning the service life of the ties installed in these tests. Some of them, however, were inspected in the spring of 1934, and were found to be in about the same condition as when inserted.

During the years of the depression, the Great Northern, in common with other railroads, was confronted with the necessity for economizing wherever possible in its track maintenance program, and as the cost of treating ties comprises a substantial item, attention was given to the relative costs of various preservatives. As creosote-petroleum treatment costs from 20 to 25 cents more per tie than treatment with zinc chloride or Z.M.A., it was decided to make more extensive use of the latter two preservatives, using creosote-petroleum treated ties only where it was not economical to install ties treated with a salt solution.

Creosote-petroleum was used with the birch and oak ties inserted in Minnesota and Wisconsin and the fir ties installed in the region between Spokane, Wash., and the Columbia River. On the remainder of the railroad's lines it was decided to use ties treated with zinc chloride and Z.M.A.

Where Installed

Ties treated with Z.M.A. were installed only in the lines west of the Cascade mountains in Washington where the rainfall is heavy, and on the Spokane, Coeur D'Alene & Palouse, an electric line in Eastern Washington, controlled by the Great Northern. The Z.M.A. treated ties were chosen for these locations in preference to those treated with zinc chloride because Z.M.A. is less likely to leach out of the wood; it is highly toxic, is not corrosive to track fastenings and is not a conductor of electricity. As to checking, it is felt that there is no preference between Z.M.A. and zinc chloride, while the cost per cubic foot of treated wood is the same for both salts.

During 1931 the Great Northern did not treat any ties with Z.M.A., but in subsequent years the number of ties treated with this preservative

was 290,680 in 1932; 231,162 in 1933, and 198,830 in 1934. During the last 10 years this road has used an average of 1,560,000 treated ties annually.

Practically all ties treated with Z.M.A. on the Great Northern during the past three years were western larch obtained in Eastern Washington and Western Montana. Both the empty and full-cell processes were used, the minimum net retention of dry Z.M.A. being 1/6 lb. per cubic foot of wood. The strength of the treating solution used was about 1.65 percent, while the temperature of the solution during impregnation approximated 70 to 80 deg. F. By treating the ties at this temperature it was found that a considerable saving in the consumption of fuel could be effected. The average treating time per charge was about ten hours. The ties were treated by the Washington Wood Preserving Company, Hillyard, Wash.

The Great Northern has also used Z.M.A. extensively in recent years in the treatment of poles. From 1930 to 1932 inclusive, 14,246 Inland Empire Douglas fir poles were treated with Z.M.A. These poles were pressure-treated for the full length, with a minimum net retention of ¼ lb. of dry Z.M.A. per cubic foot of wood. These poles were used in rebuilding the telegraph lines between the following points:

	Miles	Year
Williston, N. D., and Wolf Point, Mont.	107	1930
Cut Bank, Mont., and Summit	60	1931
Devils Lake, N. D., and Minot	118	1931
Crookston, Minn., and Grand Forks, N. D.	25	1931

As these pole lines were completely rebuilt, they afford good test installations for the soil conditions are different for each line. As with the ties, these poles were inspected in the spring of 1934 and were found to be in about the same condition as when installed.

It is felt that the Z.M.A. treated ties will have a service life equal at least to and probably greater than that which is being obtained from ties treated with zinc chloride, although it is not expected that ties treated with either of these salts will have an average service life equal to that which would be obtained from creosote-petroleum treated ties under similar operating and climatic conditions.

The Problem of the Smoke Stack

THE steam power requirements of the smaller engine terminals are such that guyed metal smoke stacks have generally proved more economical than self-supporting stacks of brick or reinforced concrete. This is due to their low first cost which, even with the shorter life obtained from stacks constructed of steel plates, has made them more economical than the more expensive types. Another factor that has had no small influence in the use of stacks of low first cost is the uncertainty that surrounds the problem of the small engine terminal and other railway facilities involving the operation of small boiler plants, because changes in operating conditions can readily lead to the abandonment of these facilities long before the life of permanent structures can be realized. As a consequence, the guyed metal stack has enjoyed extensive popularity since the beginning of railway transportation.

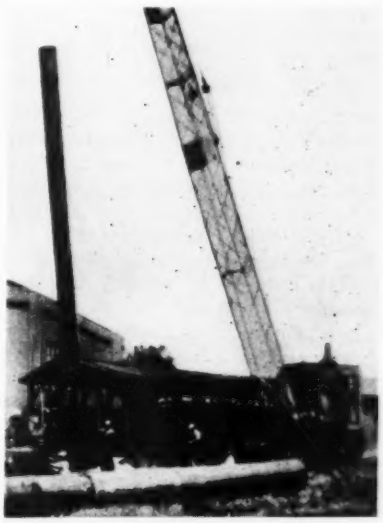
Originally, guyed smoke stacks were built exclusively of wrought iron, but with the advent of the Bessemer process, wrought iron was almost entirely supplanted by steel. However, owing to recent developments in manufacture that have resulted in a measureable reduction in the cost and an increase in the sizes of the plates that can be furnished, a number of railways are specifying wrought iron for stacks for both new construction and the replacement of old steel stacks.

Life of Stacks Varies

The life of a steel stack ranges from 2½ to 7 years, depending on the character of the coal burned and the climatic conditions. Data obtained concerning 22 steel stacks in railway service showed an average life of 5.2 years. According to an estimate of the relative cost of wrought iron and steel stacks of the average size in use on the railways, namely, about 70 ft. high by 30 in. in diameter, a wrought iron stack will justify its higher first cost when it has reached an age of 6.7 years. Beyond that age, according to these figures, the annual cost of a wrought iron stack would be less than that of a steel stack of average service life.

Because of the circumstances attending their use, practice in the erection, maintenance and replacement of steel smoke stacks involves a distinctive technic; the following facts, taken from the experience of the Chicago, Milwaukee, St. Paul & Pacific, are based largely on experience with steel stacks. Some of these practices apply alike to both steel and wrought iron stacks, while certain features are being subjected to modification with the adoption of wrought iron for their construction. Other modifications in technic have resulted from the availability of better hoisting equipment for the erection of the stacks, as well as the adoption of welded in place of riveted connections in their fabrication.

A guyed steel stack of the size commonly provided for railroad service—28 to 36 in. in diameter—receives practically no maintenance during its life cycle. The upper third deteriorates faster than the lower two thirds, but as a rule it does not pay to renew the upper portion because the lower part will usually reach the end of its life before the renewed upper part will require replacement.



Erecting a Stack

For this reason and because the most serious corrosion takes place on the inside of the stack, a detailed inspection such as could be made only by the expensive, disagreeable and rather hazardous examination of the interior is almost never undertaken. Instead, inspection is confined to ground observations for evidence that the shell is starting to rust through as indicated by smoke leakage. As a rule, this appears first at the top of the upper guy ring, as rain or condensate from the smoke, running down the outer surface of the stack, seeps into the seam between the shell and the guy ring and forms a focus for corrosive action from the outside

that continues until it breaks through to the surface that is being eaten away from the inside. A stack that has reached this stage of deterioration is dangerous and should be replaced promptly.

These same considerations militate against the lengthening of an old steel stack to obtain better draft. In one case on the Milwaukee where it was desired to increase the height by 40 ft., it was necessary to provide a new section 55 ft. long because the upper 15 ft. of the old stack was so badly corroded that it had to be cut off before the new section could be erected.

The removal of a stack that has reached a stage such that there is serious danger that the top may be broken off in a high wind is not an easy task, since it is possible that the top may break off while it is being handled. If the stack is not mounted on top of a boiler it may be entirely practical to pull it down after cutting it off at the bottom with a torch and inserting wedges as the cutting is done. In the majority of cases, however, it is necessary to lift the stack down by the same means that are employed in erection.

The Milwaukee, which has specified genuine wrought iron for 18 smoke stacks during the last two years, has developed a new design for its stacks that provides for welded joints throughout, except for the field connection required where the height is such as to require erection in more than one piece. These stacks, which are constructed of $\frac{3}{16}$-in. plates 6 ft. wide, have lap-welded vertical and horizontal joints, each ring being made slightly conical, so that the bottom of each ring laps outside of the top of the ring next below. This eliminates the presence of any horizontal edges on the outside that would form a collecting place for rainwater flowing down the outside of the stack.

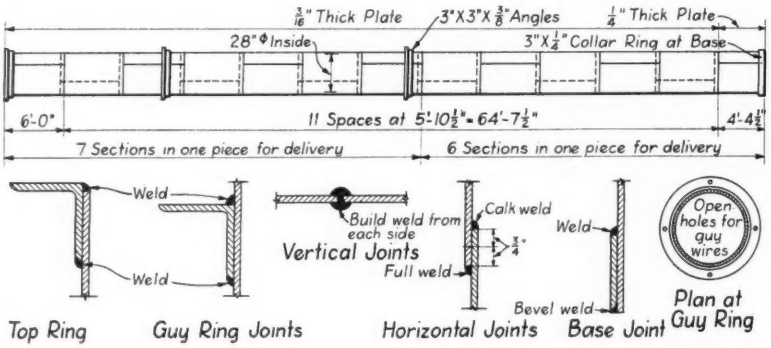
The bottom is reinforced by a collar ring, ¼ in. by 3 in., bead-welded at the top and bevel welded at the bottom. The top ring and the two guy rings are 3-in. by 3-in. by ⅜-in. angles, welded to the plates at both the top and bottom edges to insure the exclusion of water from between the angles and the plates.

Stacks that are of such height that they can be erected more conveniently in two or more pieces are provided with angle rings at the abutting ends to form bolted flange connections. Experience with welded field connections proves that it is difficult to insure a high grade of workmanship because of the conditions imposed.

Stacks are erected most readily and at the least expense with a locomotive crane. Gin poles or guy derricks are sometimes used, but it is the experience of the Milwaukee that it is usually less costly to use a locomotive crane, even where this involves the construction of a temporary track to reach the site of a stack that cannot be reached over an existing track, than it is to erect some type of stationary hoisting rig. In one case on this road, 300 ft. of temporary track was constructed and in another the wall at the end of a roundhouse stall was removed to make it possible to use a crane.

An important requisite in erection is a boom of adequate length to permit of a rope-sling hitch on the stack at a sufficient height so that it will hang in a substantially vertical position, or so nearly vertical that it can be readily plumbed by forcing it over at the bottom. In some cases, where the boom was too short to meet this requirement, the stack was plumbed by weighting the lower end with switch chains, sand bags, etc.

To spot an upper section of a stack on a lower section and to bolt up the flanged connection entails the hoisting of a man to the level of the joint in a boatswain's chair. This is usually hung from an auxiliary load line on the crane but in some cases it is hoisted by rope falls attached to the top of the stack.



Details of a Welded Stack Erected on the Milwaukee

Fissure Data Show New Trends

THE operation of Sperry detector cars during 1934 has developed interesting information relative to the number, size, location and other aspects of fissures. During the year these cars discovered a transverse or compound fissured rail every 4.95 track-miles inspected, as compared with one every 5.48 miles in 1933, and one every 12.2 miles in 1930. In other words, 20.2 fissured rails were detected per 100 track-miles in 1934, as compared with 18.2 and 8.2 per 100 track-miles in 1933 and 1930.

Another interesting trend is the increase in the number of rails containing several fissures, termed multi-fissured rails. The number of such rails has increased almost continuously since 1930. Thus, of the 27,643 fissured rails detected by Sperry cars during the last five years, about one-sixth were multi-fissured, while in 1934 approximately one-fifth were multi-fissured. About three times as many multi-fissured rails per hundred track-miles were found in 1934 as in 1930.

Another significant trend is the change that has taken place from year to year in the relation between the number of large, medium and small fissures found. Fissures are assigned to these three groups as follows: Large fissures are those that cover from 60 to 100 per cent of the area of the rail head; medium fissures, 20-40 per cent of this area; and small fissures, 0-20 per cent. In 1934 the percentage of large fissures found showed a substantial decrease, as compared with 1933, while the percentage of medium and small fissures increased. It is felt that this trend is a result of the increase in the practice of periodic testing, for with a shorter time interval between tests there is less time for fissure growth.

The accompanying table is the result of an effort to determine the weight of rail in which fissures occur most frequently. This shows the various weights of rail, the percentage that the mileage of each weight tested bears to the total mileage tested, and the percentage that the num-

ber of fissured rails in each weight bears to the total number of fissured rails found. From this table it is evident that fissured rails occur most frequently in the 91-100-lb. group, probably because of the age of the rail, next in the 111-130-lb. group,

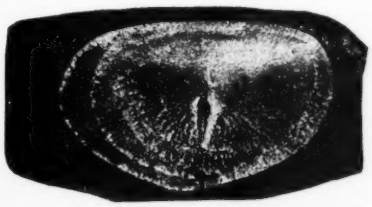
Ratio of Fissured Rails Found by Weights to the Mileage Tested—1934

Weight-lb.	Per Cent of Mileage Tested	Per Cent of Fissured Rails Found
90 or less	46	34
91-100	22	42
101-110	10	6
111-130	11	16
Over 130	3	2
Mixed or not reported	8	

and then in the group over 130 lb., the 101-110-lb. group and the group under 90 lb., in the order given. More fissured rails were found in rail weighing over 130 lb. in 1934, than in the three previous years combined.

The figures show that rail rolled in 1929 has developed considerably more fissures than the rollings for any other year. Up to January, 1934, 75 per cent more fissured rails had been found in 1929 rollings than the average for rollings of the four previous years. This figure, however, had dropped to 53 per cent by the end of 1934, largely as the result of an increased number of fissures detected in the rollings of years prior to 1929.

In 1934 Sperry detector cars found 6,014 fissured rails in tangent track, 980 in the high rails of curves, and 1,311 in the low rails of curves. One

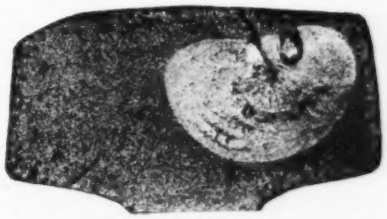


The "Halo" of Considerable Size Surrounding the Well-Defined Fissure Area is Illustrative of Rapid Growth

hundred thirty fissures were found on bridges and 33 in tunnels. Large numbers of other defects have also been located. In recent years the Sperry cars have also found, on the average, 5,500 horizontal split heads, 8,000 vertical split heads and 750 miscellaneous defects such as broken bases, split webs, etc.

Since the Sperry detector car was first developed, the question of the rate of fissure growth has assumed greater importance because there has been no way of determining, with any degree of accuracy, how long a given piece of track will be free from internal fissures after all affected rails discovered by the detector have been removed. There is ample evidence that the development of fissures usually takes place slowly. On the other hand, they sometimes grow rapidly, particularly in certain heats and rollings. Some observations made by the Sperry Rail Service are reported by that company as follows:

Near the close of a day not so long ago, a detector car picked up a two-pen indication in a 130-lb. R. E. rail rolled in October, 1929, but the result of the hand test was negative. At 8 o'clock the following morning, or after 15 hours, during which a number of heavy coal trains had passed over the rail, it was tested again and a transverse fissure covering something less than 5 percent of the rail head was definitely located. Angle bars were then applied at the location of the fissure and the rail was left in track for 13 days, when another hand test was made. This showed that the fissure now covered fully 15 per cent of the head cross section. Owing to the fact that the foreman turned up the bolts to a tight fit of the angle bars, although he was instructed to leave them loose, it is probable that the fissure did not grow



This Fissure Expanded from a Very Small Area in 30 Days

as fast as it would have on a rail that was free to bend normally under load

Another example of rapid fissure growth was found in rails of a "suspicious" heat which were tested twice in an interval of 30 days. In this length of time a very small fissure spread over 32 percent of the head area in one of the rails.

Derailments Can Be Prevented*

By A. H. Peterson

Roadmaster, Chicago, Milwaukee, St. Paul & Pacific, Chicago

TRAIN accidents and their prevention constitute one of the most serious problems with which railways of America are confronted, being second only in importance to the elimination of personal injuries and loss of life. Important in the prevention of such accidents is the control of the more unusual causes, those not associated with defective track in the ordinary sense of the word, but ascribable to such extraordinary causes as storms, washouts, men at work, etc. In this discussion I will attempt to analyze the causes of such accidents and to outline precautions that may be taken to avoid them.

These accidents may be separated into two divisions, namely those occasioned by the forces of nature, and those for which human agencies are more directly responsible. Among the forces of nature which we must combat are those of temperature, precipitation, wind and fire. Sun kinks are not as common as in former years but they are still with us. During the sudden changes of temperature common to many parts of our country, it is extremely hazardous to raise track out-of-face. When possible, surfacing should be done in the cooler parts of the day and all raised track should be tamped and back-filled as quickly as possible. Rail should be securely anchored, usually against the direction of traffic and sometimes in both directions. During hot weather, expansion allowances should be adjusted by loosening the angle bars, tapping them lightly with a maul, and retightening. In cold weather tight joints should be opened up. Places where rail has been laid adjoining that of a lighter section should be watched closely as there is always

In spite of constant vigilance and the great care that has been taken to make our tracks safe for trains, serious and costly derailments still occur occasionally. In this article Mr. Peterson discusses various precautions that should be observed to prevent derailments ascribable to the more unusual causes.

*Abstract of an address presented before the fourteenth annual meeting of the Safety Section of the American Railway Association at Cleveland, Ohio.

danger of the lighter rail giving way against the pressure of the heavier, more rugged track structure.

Wind storms have caused many train accidents by blowing cars off sidings onto main-line or other tracks, and by causing trees, telegraph poles, etc., to fall across the tracks. Derails should be provided at all dangerous points and trees removed to a safe distance from the track wherever possible. In some sections of the Southwest wind storms constitute a continual source of worry to the track supervisor owing to the drifting of the wind-borne soil. On June 12, 1933, a wind having a velocity of 20 to 34 miles an hour blew an 8-in. drift of sand over the rails on one of the western roads and caused the derailment of a mixed train. The placing of sand fences, the oiling of sandy soil adjoining the track and the planting of vegetation are some of the more common measures that have been adopted to prevent the drifting of sand.

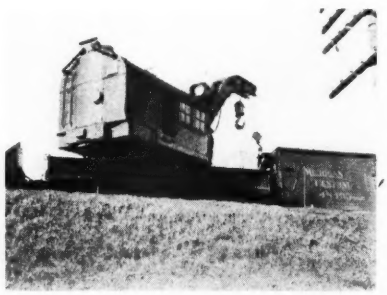
Wooden trestles impose a fire hazard, but we may expect their use to be continued on our branch lines for many years to come, perhaps indefinitely. In some cases the floors have been covered with metal sheeting to prevent their ignition from hot coals. To avoid exposure to brush or grass fires, all vegetation must be carefully cut away from abutments and piling, and regular inspections should be made for the purpose of determining that this precaution is not neglected. This also applies to wooden culverts and drains. Weed burners should be followed and all fires in ties carefully extinguished. During such times several ties in a single panel may be entirely or partially consumed, permitting the rails to get out of gage or become surface bent under traffic.

Rain and Snow

Both snow and rain are banes to the trackman and the supervisor. Heavy and unexpected rains are responsible for many derailments. On one of our Middle-Western roads, during the past year a cloudburst resulted in 5½ ins. of rainfall in three hours, with the result that a bridge under which there had not been more than 3 ft. of water for 20 years was subjected to the force of a 15-ft. flood and was washed out.

Heavy rainfall is no respector of railroad property, and adequate waterways must be provided. Ditches and culverts should be cleaned out painstakingly. Refuse should not be allowed to accumulate at the ends of cuts and all ditches should be cleaned out occasionally. The ends of wooden bridges subject to erosion should be riprapped, and bank widening should be carried forward systematically. Drainage must be provided to carry away surface water quickly, and ditches in all cases should be deep enough and have sufficient gradient not only to carry the surface water off quickly, but to drain as much as possible of the subsoil.

Water pockets in fills constructed of clay and similar materials are a constant threat because of the danger of slides. Usually such pockets result where a strata of porous material is surrounded by more dense and impervious soil in such a manner that the water cannot escape. The bottom of these pockets should be tapped by a type of drain suited to the terrain. To prevent the erosion of slopes, they may be sodded, or seeded with various types of vines, alfalfa or Bermuda grass, which will not only hold the embankment in place but arrest considerable snow that might otherwise drift over the track.



Derailments Are a Source of Expense and Delays to Traffic

Sometimes it appears that nature is assisted by human agencies in her struggle to thwart the work of man. Among the many causes of train accidents are improper flagging, premature recall of flagmen, or no flagging at all. When work hazardous to the safe passage of trains is under way on multiple-track lines, it is usually possible to take a track out of service for part of the day, if not the entire day. When this is not possible and the track is to be rendered unsafe, if for only a few minutes, reliable flagmen should be sent in each direction for a distance of not less than three-quarters of a mile. Unusual weather conditions may make it necessary for these flagmen to go a greater distance from the scene of the work. Under such conditions dispatchers should be notified in advance so as to enable them to issue the necessary train orders. When emergency work is under way, there must be a definite understanding as to when the flagmen are to come in, which should be based on the length of time necessary to complete the job at hand. In all cases flagmen must be provided with the proper flagging equipment and be able to read and write the English language. They should be chosen for their intelligence and trustworthiness.

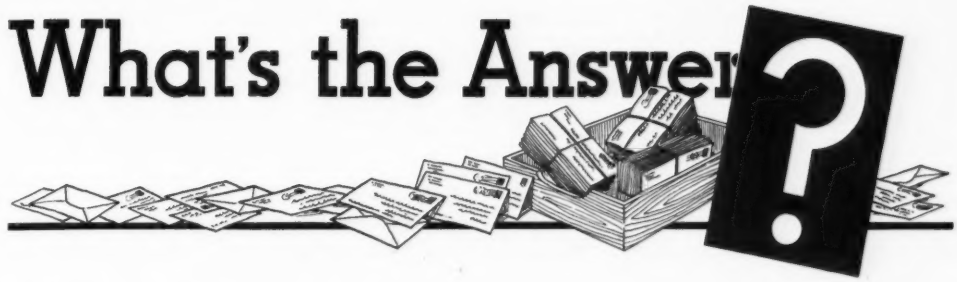
Where track is being worked on but is retained in service with a speed restriction, the necessary orders must in all cases be in writing, with a copy of the order in the possession of the foreman doing the work. Such orders must be clearly worded, legible and specific with respect to the limits of the zone of restricted speed. Skeletonized track is especially dangerous and, unless unavoidable, should not be retained in service, even with speed restrictions. In no case should trains be permitted to travel over such track at speeds in excess of five or ten miles per hour until the cribs are fully filled.

At Highway Crossings

Certain precautions must be observed to prevent accidents at highway crossings. In order to prevent heaving of the planks they should be taken up before the advent of freezing weather and all ballast between ties at the crossing cleaned out to a depth of two inches below the tops of the ties. Flangeways should be carefully cleaned out and kept clean at all times. Derailments caused by the presence of ice in flangeways are all too common, and on dirt or gravel-surfaced highways, stones and dirt dragged onto the crossings and into flangeways by vehicles present an added danger. Highway repair men operating road scrapers are sometimes careless or ignorant concerning such dangers and have been responsible for several serious train derailments. Track foreman should make it a point to inform men so employed of the possible consequences of dragging gravel or dirt onto railroad crossings. If the practice is not discontinued, the matter should be reported by wire to the proper railroad officer and the local authorities notified.

Incipient dangers are most readily found and corrected by regular and careful track inspections, but as the sections become longer, the foreman cannot always find time to patrol his track and also supervise his gang. The track inspector thus becomes his first line of defense. This employee must be carefully trained, must be able to think clearly and rapidly in any emergency that may arise, always remembering that the safety of the train service rests in his hands. The foreman, however, must be ready to patrol his track during high winds, heavy rain or other unusual conditions that may render it unsafe.

What's the Answer?



Best Time To Inspect Ties

Should the tie inspection for the next year's renewals be made in the spring or fall? Why? If the former, should the ties that are to come out be marked? How can this be done to distinguish them from this year's renewals?

Should Be Made In Fall

By C. S. KIRKPATRICK
Chief Engineer, Gulf Coast Lines, Houston, Texas

Tie inspections should be made in the fall, because information as to the number of ties required for the succeeding year is necessary in the preparation of the maintenance of way budget; furthermore, an inspection at this time is more dependable than a spring inspection. It is our practice, before this inspection is undertaken, to prepare and send instructions to the division engineers and roadmasters to be read and discussed locally. We then hold a general staff meeting where they are again discussed to insure that they are thoroughly understood and that the inspection will be uniform.

Many things affect the inspection and spotting of ties. For instance, where rail is to be laid and ballast applied, tie renewals are usually heavier than elsewhere. These locations are pointed out at the staff meetings, following which the roadmasters make the inspection, accompanied by their section foremen, and at this time all ties to come out are marked with white paint.

Following this, the division engineers check at least two miles on each section of their respective territories. This is then followed by a check made by the chief engineer who examines typical sections on each division and those estimated to require the heaviest renewals. With this information in hand, the tie requirements for the ensuing year are estimated. In doing this, the ties inserted between the date of inspection and the end of the year are deducted from the inspection figures to set up the requirements for the next year.

The spotting record is segregated by miles and by telegraph posts to facilitate the tie distribution and to minimize the amount of trucking that might otherwise be necessary. We use white paint to indicate the ties that are scheduled for renewal. In some cases, however, when renewals are being made, occasional ties are found to be capable of another year's service, and they are not removed.

Favors Fall Inspection

By L. J. DRUMELLER
Division Engineer, Chesapeake & Ohio, Hinton, W. Va.

I believe that better results will be obtained from a fall tie inspection than from one made in the spring, for the reason that there is then no chance for confusion as to which year's renewal the ties belong. Also at this season other work is being budgeted, so that the tie inspection fits in naturally. At the same time it gives ample time for distributing the ties during the winter, so that they will be on the ground well in advance of the renewal season. Again, track work is usually cleaned up in the fall, thus providing more favorable conditions for a detailed inspection.

Where the inspection is made in the spring, there will be an advantage in using two colors of paint for spotting ties, to distinguish the year for which their renewal is slated. This necessity does not exist, however, where the inspection is made in the fall, since there will then be no overlap because all ties scheduled for renewal during the current year should have been inserted prior to the inspection.

A Year Is Too Long

By W. H. SPARKS
General Inspector of Track, Chesapeake & Ohio, Russell, Ky.

My preference is for a fall tie inspection, for although there should be no difficulty in detecting a year in advance of their renewal most of the ties that should come out, there will always be a considerable percentage

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Send your answers to any of the questions to the What's the Answer editor. He will welcome also any questions you wish to have discussed.

To Be Answered in June

1. *When relaying rail, is it practicable to attempt to salvage the old bolts? If so, are these bolts suitable for use with new rail? With the released rail? Why?*

2. *What considerations justify the additional expense for ballast decks on steel bridges? On timber trestles?*

3. *Where weeds are destroyed by burning, chemicals or discing, at what stage in their growth are these methods most effective? Is this the same for all weeds? Why?*

4. *How does one go about the replacement of the sills, joists and floors of a small combination station when both the passenger and freight facilities must be kept in service?*

5. *Is it worth while to clean gravel ballast? If not, what means can be employed to overcome dirty ballast?*

6. *How should one construct an intake in a small stream carrying a heavy load of silt?*

7. *Is there any advantage in fastening base plates to spring frogs? If so, is it better to weld or rivet them? Why?*

8. *Is a round or a flat brush preferable for painting steel bridges? For painting wood surfaces? Why?*

of borderline cases about which even the most experienced trackmen will differ. If the inspection is made in the fall, most of these cases will have been cleared up and the results of the inspection will be more nearly in accordance with the facts.

All ties scheduled for renewal should be designated by a spot of paint on the rail. As this paint is likely to persist, it is good practice to use different colors for different years, and this system is as well adapted for a spring inspection as for one made in the fall.

Spring Inspection Is Best

By District Engineer

I favor a spring tie inspection because the information obtained at this time gives the purchasing department ample opportunity to make its tie contracts and secure early delivery of the ties. It insures, therefore, more thorough seasoning of the wood and permits the ties to be treated months earlier than is possible where the inspection is made in the fall. It is well known that seasoning is more rapid during the summer and early fall than during the winter.

Spring inspection also allows delivery of the treated ties to be made before the tie renewal season opens, so that the summer schedule is not interrupted to unload ties, and the probability of delay to the tie program by reason of late receipt of needed ties is eliminated.

An experienced inspector will make as accurate and dependable a selection of failing ties in the spring as in the fall, and if the ties scheduled for removal during the current year have been properly designated, there need be no confusion. The marking should be done with paint, as such marks can be easily distinguished, even after a year's exposure. A different color should be used each year.

Protection from Brine Drippings

What methods can be employed to protect the floor system and bottom laterals of open-deck steel bridges from brine drippings?

Involves Much Uncertainty

By John L. Vogel
Bridge Engineer, Delaware, Lackawanna & Western, Hoboken, N. J.

This is a question in which there is still much uncertainty for any one connected with the maintenance of steel railway bridges. It is certain that if paint is relied on as the protective material, it will be necessary to clean and paint the floor members at short intervals. It is a fact that steel rails and track fastenings have been protected against brine drippings with satisfactory results by the application of hot oil having a high asphaltic content. This result has been obtained, however, only by continued applications which have resulted in the building up of a highly adhesive crust or covering. If this method could be employed to protect the bridge members which are subjected to brine drippings, it is probable that equally satisfactory results might be obtained.

Tests along this line have been made with fair results, by thoroughly cleaning the affected members and applying several coats of asphaltic oil containing 55 per cent of asphalt. These applications were made at less expense than would have been necessary for painting, although the cleaning costs were the same. The second coat should be applied several months after the first one and a third coat the following year. It is advisable to make the applications by spraying, as this method is easier, more rapid and the coatings are more uniform. In this way, it is possible to build up a heavy protective crust which will adhere to the steel surfaces.

Numerous brands of paint, for which acid-resisting qualities have been claimed, have appeared on the market, but little information is obtainable as to the life of these materials or their protective value under actual service conditions, since the claims are generally based on laboratory tests, which are in no wise comparable to the actual conditions of service.

Except for the hazards involved for the men working on the structure, the use of emulsified asphalt treated with asbestos and troweled onto the steel surfaces, has some advantages. Where this material has been tested as a paint protection, it appears to be accomplishing satisfactory results and I am inclined to believe that it will also resist brine drippings.

It has been stated that several roads are using certain greases for the protection of the top flanges of girders and stringers against brine drippings, and that these materials are accomplishing good results. Time is needed, however, to permit final conclusions to be drawn as to their effectiveness. In the design of new structures, the floor and lateral systems can be assured longer life in the face of brine drippings by the use of copper-bearing steel for the members affected, or the use of wrought-iron plates as a covering. Furthermore, a covering of thin rust-resisting metal plates or of transite can be fastened directly to the ties.

Should Not Disregard

By E. C. Neville
Bridge and Building Master, Canadian National, Toronto, Ont.

Those members of a bridge which are subject to brine drippings are usually the most inaccessible for cleaning and painting, and as brine causes rapid corrosion, a serious problem is created. This is particularly true because it is the main-line structures, which carry the heaviest traffic and fastest trains, that have the severest exposure to this destructive action. To disregard the seriousness of the situation is either to invite disaster or heavy expenditure for renewal of the parts affected. For these reasons, one is justified in going to considerable length to assure the best obtainable protection.

Many methods have been employed, generally with indifferent results. Usually they have been rather inexpensive and of a temporary character. Circumstances do not always permit the heavy expenditure required to provide a more permanent form of protection, while experience has shown that some of the so-called permanent forms of protection which have been applied at considerable cost are little better than some of those more temporary in character.

One of the simple but less effective methods that have been used widely is the application of oil, asphalt, coal tar or mastic preparations which are impervious to water and which are not affected by the salt in the brine. Penetrating oils have been applied by spraying the exposed surfaces once or twice a year. As these are slow-drying materials, the successive coatings finally build up a heavy coating which displays considerable resistance (or rather a retarding effect) to brine drippings.

Roofing asphalt applied hot has been used extensively, but it alligators and cracks as a result of temperature changes and evaporation of the volatile oils, so that it soon loses its protective value. Emulsified asphalts suffer from the same defect. Coal

tar is a fair retardant, and when mixed with sufficient asbestos fibre and applied as a heavy paste, it remains tough and plastic for several years, thus affording considerable protection; yet like the others mentioned, this material is not permanent.

Recently a method has been developed for applying a noncorroding metal coating in the field in much the same manner as paint is sprayed on surfaces to be painted. While this method is yet too new to draw final conclusions, accelerated tests in the laboratory have given promising results. Several applications have been made to existing structures, and while the first cost is considerably more than that of the usual coatings, it is believed to be worthy of serious consideration as a means of combatting corrosion from brine drippings.

Brine Drippings Not Alone

By P. G. Lang, Jr.
Engineer of Bridges, Baltimore & Ohio, Baltimore Md.

While this query limits the discussion to brine drippings as an agency of deterioration in the floor systems and laterals of metallic bridges, this role is shared by it with the combination of coal particles, cinders and other dirt, and rain water which accumulate on the surfaces of the individual members. In accordance with prevailing usage, efforts to protect against these agencies ordinarily take one or a combination of the following forms: (1) Insertion of sheet metal between the ties and the supporting structure; (2) completely planking over the top of the ties; (3) placing sheet metal on top of the ties; (4) application of a bituminous emulsion over the paint to form a heavy protective coating over the exposed surfaces. Actually, none of these expedients has proved entirely satisfactory and, in many cases, each has shown itself to be inadequate.

This evil has long been recognized by the A.R.E.A., one phase of the question being epitomized concisely in the following sentence taken from the 1928 Proceedings, which represents the fruits of long research:

> Information obtained from various railroads indicates that no one protective coating, which is entirely satisfactory, has been found.

Apparently, a primary source of the difficulty experienced in this respect is the tendency of current bridge floor design to neglect entirely and even to counteract the normal cleansing properties of natural agencies, such as wind and rain. Indeed, in the light of experience, the accepted standard for bridge floors, especially for open-floor bridges of the deck type, seems obsolete and unsuitable.

The inner steel guard rail on bridges is an essential adjunct, and functions in an admirable manner in cases of derailment. The outer guard rail, of timber, whether notched, spiked and bolted or merely spiked or bolted to the ties, is designed primarily to prevent the bunching of ties in case of a derailment. For this purpose it is usually inadequate as the segments of guard rail between the notches are ordinarily incapable of resisting the shearing stress induced by the pressure on the ties incident to a derailment, so that the wood splits along the grain, the projecting sections of guard rail between the ties are detached and the ties bunch. Such cleavage is also caused or induced by the process of weathering.

In the majority of cases the timber guard rails are situated directly over the structural member supporting the ties, upon which, serving as a barrier to the action of wind and rain, it directs the course of brine and other corrosive substances which may be deposited on the bridge deck. Further, an inevitable corollary to the use of outer timber guard rail is increased fire hazard, as the pocket thus formed readily becomes a repository for incandescent particles from passing locomotives, from which a destructive conflagration may easily originate.

A more effective protection against the destructive action of such drip appears to be one of the advantages incident to the abandonment of the outer timber guard rail and the substitution of beveled blocks between the ties as a preventive of bunching. Design change along these lines has received much study in the recent past. Information assembled by the A.R.E.A. in 1930 indicated that two American roads had then definitely adopted this change, with eminently satisfactory results.

At best, the use of local protection, in the form of plank, sheet metal or bituminous emulsions, is a temporary and doubtful expedient. The problem is one which, as a phase of the drainage element, demands attention from the bridge designer. The use of beveled blocks not only removes from the bridge deck a pocket for the accumulation of destructive and inflammable substances, but provides a covering for the top of the steel member between the ties, and a sloped upper surface to insure the expeditious discharge of water, dirt, etc., deposited upon the bridge deck.

Recognizing Termite Infestation

How can one determine whether a building or other structure is infested with termites?

Are Difficult to Find

By Building Engineer

Two indications of termite infestation stand out prominently, the first being the swarming of the winged insects, usually in the spring, although there may occasionally be a second swarming period some months later. The other is the characteristic shelter tubes or runways between the nest in the ground and the wood in the building. If the wood is in contact with the ground, these tubes will not be present, however. Termites shun the light, for which reason they construct their tubes under porches, on the inside of foundation walls and other obscure places, selecting the darkest corners for this purpose.

Another sure indication is the failure of flooring, floor joists or basement window frames. They may also be found in weatherboarding and studding by sounding with a light hammer, the wood giving out a dead sound that can easily be distinguished. It should be kept in mind, however, that these determinations are sometimes difficult and that an investigation may have negative results unless made by someone familiar with their habits, since the insects themselves are never seen except when they swarm.

Flying Termites Sure Sign

By Thomas E. Snyder
Senior Entomologist, Forest Insect Investigations, United States Department of Agriculture, New Orleans, La.

Indications of termite infestation are the annual emergence of large numbers of flying termites, which should serve as a warning that the woodwork of the building is infested, while the point of emergence of the winged adults indicates the approximate location of the infested timbers. Even if the insects are not observed swarming, large numbers of dead winged adults or of the discarded wings will be found nearby. Another indication is the presence of branch-

ing shelter tubes of small diameter, made of earth mixed with finely digested wood, on the foundation timbers or other foundation materials, through which the ground-nesting insects travel from the ground to the woodwork. Another method of determining the presence of termites is that when the wood is tapped, it will sound hollow; again some piece of furniture may break through the surface of the wood.

Damage Usually Concealed

By H. R. Duncan
Superintendent of Timber Preservation, Chicago, Burlington & Quincy, Galesburg, Ill.

Subterranean termites are the only type operating in the northern and eastern sections of the country, although many species are known. These insects are usually very successful in concealing their operations and the insects themselves are rarely seen except when they swarm. They work in wood that is not exposed to sunlight. For these reasons, ordinary outside inspection or observation seldom discloses termite infestation, although it may occasionally disclose the presence of the tubes which serve as the highways between the nest in the ground and the source of food supply in the structure.

Not infrequently, the damage done by termites is sufficient to weaken some member or members, particularly in the substructure, and occasionally the interior of the sills or siding may be seriously damaged, and subsequent weathering may disclose evidence of this damage. If the outside surface shows signs of damage, if shelter tubes are observed, if doors get so that they do not close properly and appear to be hung improperly, or if the building seems to have settled or is out of level at any point, it is probable that it is infested with termites, and a complete and searching examination should be made.

In making this inspection, all foundation material beneath the building and at other points not exposed to sunlight should be examined carefully. This can best be accomplished by using a flashlight or extension cord and globe, a chisel, a heavy screw driver and an ordinary claw hammer, to test every member in contact with the ground, or close to it, and with any type of masonry. This inspection must be made on the inside and underneath the building and in all dark corners as well as in poorly ventilated areas.

Replacing Failed Pipe Culverts

What is the best method of replacing a pipe culvert that has failed?

Several Methods Available

By L. J. Drumeller
Division Engineer, Chesapeake & Ohio, Hinton, W. Va.

Several methods are available for replacing pipe culverts, depending on their size and kind, and on the local conditions. Culverts 36 in. and larger can be replaced by jacking another line of pipe alongside the old one and, if it is suitable, the excavated material can be used to backfill the old pipe. If the culvert is less than 36 in. in diameter, it may be preferable to use a larger size of pipe, not less than 36 in., and jack it around the old pipe, pulling the latter out through the new one as the work advances.

If the conditions are not favorable for installing the larger pipe or it is not economical to do so, a good method may be to thread a new pipe of slightly smaller diameter through the old pipe at the point of failure, preferably using corrugated metal pipe with inside joint bands, which will reduce the capacity of the culvert only slightly. After installation, the space between the old and new pipes can be filled with cement grout under pressure.

If none of these plans is practicable, it may be necessary to cut an open trench through the embankment to remove the old pipe and install the new one. In most cases, however, it is more economical, provided the nature of the material permits, to jack the new pipe through the embankment and fill the old openings than to install the falsework necessary to carry the track across the open trench, while the necessity for slow orders is eliminated.

Several Factors Involved

By Andrew Finnes
Master Carpenter, Great Northern, Minot, N. D.

Where the pipe is small and the embankment low, the open-trench method is to be preferred, provided the work can be done between trains. If the interval between trains is not sufficient, the track can be carried on stringers supported on mud sills placed far enough back of the excavation to insure against caving. For large pipes or high embankments, an open trench can be excavated on each side as close to the track as is safe and the pipe jacked through the remainder of the embankment. In making the excavation ahead of the pipe, provided the material is well packed and stable, it will be helpful to dig the opening slightly larger than the outside diameter of the pipe, as this will reduce the load on the jacks. The advantages of jacking are that timbering becomes unnecessary and there is no interference with traffic.

Give Early Attention

By G. O. Broussard
Roadmaster, Southern Pacific, Morgan City, La.

A failing culvert should be given preferred attention at the first sign of failure because, while the process of failure may be slow in some cases, one never can tell when it may be accelerated. Ordinarily, the cost of doing the work at this stage is considerably less than if failure is allowed to progress to the point where action becomes necessary. On this basis, the best method is to clean the opening and insert a pipe just enough smaller to slip through the old culvert, being careful in both operations to prevent caving at the point of failure. In general, the reduction in the area of the waterway will be negligible, as most culverts have some margin of safety.

Local Conditions Control

By C. P. Gilmore
General Supervisor of Bridges and Buildings, Western Pacific, Oakland, Cal.

Controlling conditions include the depth of the culvert and the area of the waterway. Where the cover is less than 8 to 10 ft., we employ the open-trench method as the most economical, unless traffic conditions forbid slow orders. For greater depths, we use the threading method, if runoff conditions will allow a slight reduction of the area of the waterway. For small openings, we place a full-round corrugated metal pipe through the barrel in 6-ft. lengths, using a band coupler with the tightening clamp inside, and grout between the old and new pipes. We have used this method for culverts up to 190 ft. long and as small as 24 in.

For larger structures, we adopt the tunneling method to remove the old

structure, replacing it with the nestable, knock-down type of corrugated metal culvert, thus avoiding the necessity for timber sets. In loose soils, however, we use temporary drifting two or three feet in advance of the pipe to protect the workmen. In this method, the pipe must be large enough to provide room for the workmen, as the excavating and placing of the couplers is done from the inside of the pipe and the back tamping is done as the work progresses.

If the old structure is too badly broken to permit threading, we seek a new location for either jacking or tunneling. We have been successful with both methods, having completed installations up to 200 ft. by jacking and 240 ft. by tunneling. Ordinarily, however, I would limit jacking to about 120 ft. Both methods afford an inexpensive means of replacement, jacking usually being the cheaper for sizes up to 48 or 54 in. and for short culverts of larger sizes, while tunneling is less expensive for large culverts, 150 ft. or longer.

Widening Gage on Curves

When gage is widened on a curve, where should the widening start? Should the widening be done on the line or the gage side? Why? How should it be tapered?

Should Start with Spiral

By O. H. Carpenter
Roadmaster, Union Pacific, Rawlins, Wyo.

If the curve is spiraled, the widening of the gage should start at the point of spiral and increase regularly to the full amount at the point of circular curve. If there is no spiral, the widening should be done on the tangent adjacent to the curve, beginning at the end of the runoff and progressing regularly to the maximum at the point of curve.

Since it is necessary to keep the outside rail of the curve to smooth and exact line at all times, the widening of the gage should take place on the inside rail or its prolongation. I regard the outside rail of the curve as the line rail, regardless of whether this corresponds to the line rail on the adjacent tangents, for which reason it is proper to say that the widening should be done on the gage rail. After the maximum width is reached at the point of curve, this width should be continued uniformly around the curve and be tapered off on the spiral or tangent in the reverse of the method used to widen it.

Makes 8 Deg. the Limit

By H. E. Herington
Section Foreman, Minneapolis & St. Louis, Jordan, Minn.

While standard gage must be maintained accurately on tangents for best results, experience has shown that it is impracticable to maintain standard gage on curves sharper than eight degrees. If an attempt is made to do so, wear on the rails is rapid and the cost of maintenance is increased considerably. For this reason it is permissible to widen the gage on curves of eight degrees or more. This is done ordinarily at the rate of ⅛ in. for each increase of 2 deg. in curvature to a maximum of 4 ft. 9¼ in.

The widening of the gage should start at the beginning of the easement curve, provided there is a spiral, or at the end of the runoff from the superelevation if the curve is not spiraled. In either event, the tapering should progress uniformly to the point of full curvature, and the widened gage carried to the opposite end of the curve where it is tapered off in the same way as it was widened. The widening should be done on the low rail to avoid disturbing the line at the approach to the curve.

Standard Gage to 5 Deg.

By Armstrong Chinn
Chief Engineer, Alton, Chicago

As a rule, standard gage is maintained on curves up to and including five degrees. Above this limit, gage is widened, usually ¼ in. for curves between 5 and 10 deg., and ½ in. for curves sharper than 10 deg. The widening should begin at the beginning of the superelevation so that both reach the maximum at the beginning of the curve. If the curve is spiraled, the widening should be tapered to correspond in rate with the superelevation on the spiral. If the curve is not spiraled, the widening should correspond in the same way with the runoff which will then of course be on tangent.

The widening should be done on the gage side because the line side, which should be on the high side of the curve to guide the wheels smoothly, should not have any irregularities such as would result from widening the gage on that side.

How to Use Track Wrenches Safely

What precaution should be observed in the use of track wrenches to avoid injury to trackmen?

Only One Safe Way

By C. R. Schoenfield
Roadmaster, Chicago, Burlington & Quincy, Aurora, Ill.

While there are numerous designs of wrenches and much difference of opinion as to which is the best, my own experience is that the design has little to do with personal injuries—it is the way the tool is used. There is a safe way to use a track wrench of any design, and if personal injuries occur, the responsibility must rest with the foreman and the user. The foreman is responsible for the condition of the wrench and the man using it is at fault if he fails to follow instructions as to its use.

Few injuries occur when wrenching new bolts. It is the general practice, unless prohibited, to stand on one side of the rail and tighten the nuts on the other side, as the work can be done much faster. This should not be done on general bolt tightening, however, if safety is given first consideration. The condition of the bolt must first be examined. If it has previously been tightened several times, it will be necessary to tap the nut lightly with a maul, and if it is corroded, a rust remover will be of considerable help. When the tightening is started, the man should stand facing the nut on the same side of the rail as the nut on which he is working. The first turn should be to the left to break the set and loosen it, after which it should be turned to the right a one-quarter turn. If the bolts are in such condition that one man cannot tighten them, a second man should be placed on the same side of the rail to help him.

It is unsafe to lengthen the wrench by means of a pipe for wrenches are made to provide a specified leverage, and to tighten the bolts, not to break them off. A foreman who permits this practice is inviting personal in-

juries. A man tightening bolts must not use his whole strength if he would do his work safely. If he stands in an awkward position, as straddling the rail, and uses all of his strength, he has no way of protecting himself if the wrench slips or breaks. No man will fall when using a wrench if he has been instructed how to use it properly and follows instructions.

Gives List of Rules

By J. L. Southard
Assistant Cost Engineer, Chesapeake & Ohio, Columbus, Ohio

Never straddle the rail. Always face the work with the body parallel to the rail. Pull the wrench upward; never pull or push it down, unless the feet are wide apart and the body is braced to resist a fall if the wrench slips. Be sure that the jaws have full bearing on the nut; with some types of joints this is difficult because of interference from spike heads, but where this occurs the spike should be removed and replaced after the bolts are tightened. Do not use a wrench too large for the nuts or one having the jaws spread, worn or cracked. Never attempt to close the jaws of a spread or worn wrench by hammering or placing in a vice. A wrench should be reconditioned in the shop by expert workmen.

Worn Jaws Are Unsafe

By O. H. Carpenter
Roadmaster, Union Pacific, Rawlins, Wyo.

Probably the most frequent cause of injury when using track wrenches results from men not standing in the proper place and manner. A man using a wrench should stand on the same side of the rail as the nut which he is tightening, facing the nut, with his feet spread well apart, so that if the wrench slips he will not lose his balance and fall. Standing with feet together, astride the rail, with one or both feet on the rail or on the opposite side from the nut, should not be permitted.

Next in order as a cause of accident, is the use of wrenches too large for the nut, including wrenches that have become worn so that they do not fit properly, causing the jaws to slip off of the nut. A foreman who is in charge of a gang should know that wrenches of the proper size are being used and should inspect them frequently to see that they have not become worn.

Section men sometimes put pipe extensions on their wrenches. This should not be permitted, as the tools are made to provide the necessary leverage for the proper bolt tension without excessive exertion. No wrench should be longer than 48 in. and this length is needed only for the largest bolts. It is difficult to prevent longer wrenches from slipping.

Same As for Other Tools

By Robert White
Grand Trunk Western, Drayton Plains, Mich.

In general, the precaution is the same as for other tools, namely, use them only for the purpose for which they were designed. Do not use worn or defective tools, and do not abuse them in use. The still common use of the wrench as a drift pin is dangerous and is a frequent cause of injury. In striking the jaws with a maul, splinters are likely to be broken off, while this abuse is quite damaging to the tool itself, as the jaws become sprung so that it slips off the nut. Before putting pressure on the handle, the trackman should know that he has a solid footing; that the wrench has a full bearing on the nut; that he is braced so that if the wrench slips he will not fall on or over the rail; and that other men are not working so close as to interfere with his movements. If these rules are followed and ordinary care is exercised in the use of the track wrench, there will be few injuries from the use of this tool.

Hold Foreman Responsible

By W. H. Sparks
General Inspector of Track, Chesapeake & Ohio, Russell, Ky.

No wrench should be used unless the foreman knows personally that it is in good condition. The jaws should have sharp square edges, without other wear; if they have been sprung the wrench should not be used. It is extremely dangerous to close the jaws by pounding or by applying pressure in a vice, as is often done, since it is quite likely that a crack will be started, which will later have disastrous results. Men should be taught to stand properly and brace themselves against a fall in case the wrench slips. Spike heads that interfere with the wrenching may cause the tool to slip, this being one of the common causes of injury. The best way is to pull the spike.

Constructing a French Drain

How should a French drain be constructed? What are its advantages? Its disadvantages? What maintenance does it require?

Low Cost Is Advantage

By Frank J. Meyer
Assistant Engineer, New York, Ontario & Western, Middletown, N. Y.

To construct a French drain, a trench should be dug with the bottom carefully graded from the source toward the outlet. The trench should then be filled with stone, so arranged as to give as much room for water as is consistent with stability. Flat stone may be used, alternating layers of large and small stones; by bridging two small stones with a large one, a continuous channel can be formed for the full length of the drain. Where cobble stones are used, the larger sizes should be placed at the bottom and the smaller ones above them. Near the top, the filling should be finer porous material.

One of the advantages of the French drain is its low cost, particularly where the stone is available without cost. It is stable under the track and reasonably effective where the volume of water to be drained is not large. On the other hand, it has numerous disadvantages: It will carry only a limited amount of water; in some soils it clogs easily; unless suitable rock is available near the site, the cost may be more than that for a tile drain; and it is not desirable in localities subject to heavy showers, followed by considerable runoff.

Pipe Drains in Long Cuts

By W. E. Tillett
Assistant Foreman, Chesapeake & Ohio, Maysville, Ky.

In embankments, a French drain should be about four feet wide, with a well graded bottom for quick drainage. The trench should be filled with coarse stone, the larger pieces at the bottom and the smaller ones at the top, with uniform graduation between. It is then finished with ballast-size stone almost to subgrade and topped with cinders. In cuts the main or outlet drain should be six to eight feet wide and deep enough to serve all of the laterals, which are con-

structed the same as on fills. If the cut is long, it may be better to lay a pipe drain for the outlet. There are no disadvantages to a French drain except its limited carrying capacity. I recall one exceptionally muddy stretch of track where French drains were installed in 1929 to drain the water pockets. They are still functioning, have required no maintenance and the roadbed has been completely stabilized.

Construction Is Simple

By M. Donahoe
Division Engineer, Alton, Bloomington, Ill.

French drains are used widely for draining water pockets in the roadbed in both cuts and embankments. These pockets invariably form under one or both rails and no matter how extensively they may develop, the deepest part remains under the rail. They may be of any length up to 20 or 30 ft. in ordinary cases, but in exceptional cases they may be continuous for several hundred feet. The French drain is particularly adapted for draining these pockets because it is easily made at small cost and it remains effective for long periods.

To construct such a drain in a fill, we dig a trench about 24 in. wide extending under the track, deep enough to be well under the low spot in the pocket. The trench is then filled with coarse stone to the surface of the roadbed. If the water pocket extends for some distance, we install these drains at intervals of 15 to 25 ft. as far as the soft track extends.

A French drain is constructed in a cut in the same way, except that we make soundings by boring to determine the depth of the water pocket and thus of the outlet that must be provided for the drain. Where this outlet is deeper than the surface ditch, we use tile drains with cinder backfill instead of the French drains. The advantages are ease of construction; low cost; complete effectiveness, if they are properly constructed, for periods of from three to five years, depending on water and soil conditions; and ease of replacement when they become clogged. I know of no disadvantages of this type of drain. No maintenance is required.

Width Should Be 4 Ft.

By G. O. Broussard
Roadmaster, Southern Pacific, Morgan City, La.

In embankments less than 10 ft. high, French drains should be excavated to the natural ground and back into the roadbed far enough to tap the water pocket. They should be at least four feet wide and filled with coarse rock to provide ample water way. They need to be cleaned out frequently or they become clogged and lose their effectiveness.

Laying a Pipe Line Through a Swamp

What methods can be employed to lay a pipe line through swampy ground where the trench cannot be kept clear of water? What precautions must be observed? How can the line be tested for leaks?

Extreme Care Necessary

By C. R. Knowles
Superintendent of Water Supply, Illinois Central, Chicago

Extreme care must be exercised when laying a line of pipe in wet trenches. If it is at all possible, the water should be kept out while the pipe joint is being made. Where this is not possible, even greater care must be exercised. While lead-wool, composition and even molten-lead joints can be made under water, it is difficult to get even lead-wool to compact properly when wet. The unfavorable working conditions make it still more difficult to secure a dependable job.

Where screw or flange joints are used, the only precaution necessary is to keep dirt out of the joint. It is possible to make the joints above ground and lower the pipe into the trench, but great care is necessary to prevent distortion of the joints. It is sometimes feasible to build a coffer dam at each side of the joint and keep it pumped out while the joint is being made. If the yarn is allowed to become wet in handling, kerosene should be poured into the joint before the molten lead is poured.

Where pipe lines are laid in wet trenches, the material at the bottom of the trench is usually too soft to provide a good bearing for the pipe. In this event it may be necessary to place wood blocking under the pipe to hold it to vertical alinement. This is particularly desirable while laying the pipe and during backfilling, as there is then less tendency for the pipe to settle after the backfilling has become compacted, because the pipe, when filled with water, will weigh slightly more than the soil displaced. In some cases, in filled or soft swampy ground, it is advisable to place piers or blocks under each length of pipe.

If the covering of water above the pipe is shallow, a satisfactory test can usually be made with water under pressure by examining the joints closely with the hands. As a rule, however, submerged pipes should be tested by air. This is generally done in lengths of about 1,000 ft., but better results will be obtained if the test sections are reduced to about 300 to 500 ft., particularly where the water conditions are quite unfavorable.

Affords a Test of Skill

By General Inspector of Water Stations

Laying a pipe line through a swamp usually affords a severe test of the skill of the water service forces. It is always advisable to avoid the conditions laid down in the question if this is at all practicable, even to the extent of detouring the pipe line around the swamp. In this connection, it should be borne in mind that the difficulties involved in such construction do not end when it is completed, but continue as long as the line is maintained.

Conditions surrounding the making of joints in a trench filled with water are so unfavorable that they should be eliminated if possible. Fortunately, the use of a cradle makes it practicable to overcome this handicap so that the joints can be made above the water and the pipe can be lowered into the trench progressively as sections are added. This is the best method which I know, but the most extreme care must be exercised to insure against springing or distorting the joints as the pipe is lowered, as later leaks mean much trouble for the maintenance forces and possibly considerable loss of water.

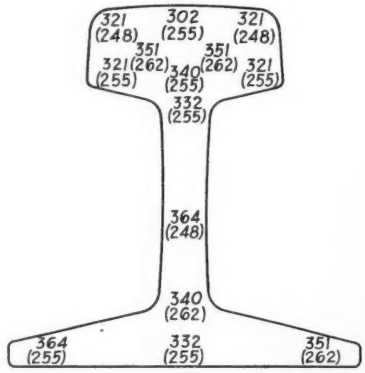
Local conditions will dictate the precautions necessary to keep the pipe line in good vertical and horizontal alinement. Usually a pipe line through a swamp demands some sort of support to insure satisfactory alinement.

To test the efficiency of the joints, the line should be isolated into sections of, say, 300 to 400 ft., before the trench is backfilled, and compressed air applied. If there is any leakage, it will be indicated by a stream of bubbles formed by the escaping air.

New and Improved Devices

Heat-Treated Crossings

ADDITIONAL facts have been made available concerning the heat-treatment of standard analysis carbon-steel rails developed some time ago by the Bethlehem Steel Company for use in the fabrication of railroad crossings as a means of greatly increasing wear resistance. The term heat-treatment, as employed in this case, signifies the complete quench and anneal method. The details of its application to this particular purpose



Effect of the Treatment on Brinell Hardness. Figures in Parentheses Show Hardness Before Rail Was Treated

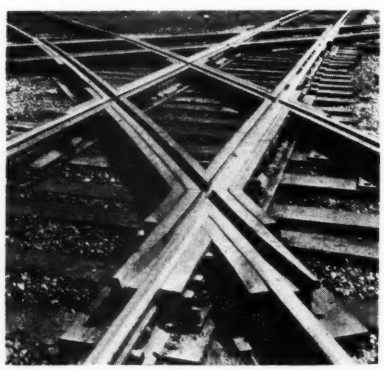
were worked out after extensive study of various processes, and the method requires elaborate furnace equipment, exacting temperature control and adequate provision for retarded cooling.

The effect of this treatment is by no means limited to the surface, as it has been demonstrated that the entire cross section of the rail is toughened and hardened. The accompanying drawing of a rail section illustrates the uniformity in hardness obtained. Thus, the component rail parts of trackwork pieces, when machined from this rail, in turn possess the average physical properties of the original or normal section. It is felt that this uniform result could not be obtained in rails treated after machining because the heat-treatment which is adapted to the regular rail section would not be suitable to the thinner machined part because of the difference in mass.

A fair average approximation of the physical properties of a rail steel, before and after the Bethlehem heat treatment, is as follows:

	Untreated Rail	Treated Rail
Elastic Limit, p.s.i.	83,000	126,700
Tensile strength, p.s.i.	137,000	177,400
Elongation, per cent	8.8	7.7
Reduction of area, per cent	12.1	11.7
Brinell	282	361
Impact, Izod ft.-lb.	2	7

It will be noted that the increase in elastic limit and in tensile strength has been obtained with little loss of



Three Crossings of Heat-Treated Rail

ductility. The hardness has been increased some 30 per cent, and there has also been a decided elevation of the impact value. The higher ratio of elastic limit to tensile strength makes it necessary to observe certain precautions in fabrication. In general, it is advisable to make bends cold because resort to heating has a tendency to destroy the beneficial results of the heat treatment and to make the metal brittle.

Rails for heat-treatment are selected with special reference to the part of the ingot from which they are rolled. No "A" rails are used. It is customary to make etch tests of the rails before they are treated to check the cleanliness of the steel. In order to determine whether the results of the heat-treatment are uniform, etch tests are also made after treating.

These heat-treated rails are now being fabricated into various types of railroad crossings and other equipment and are also sold to other fabricators. They are recommended especially for use in such special trackwork as bolted crossings of the butt type, in crossing angles ranging from 90 to 35 deg., (A.R.E.A. plans 701 to 704, inclusive) and from 90 to 30 deg. (A.R.E.A. plans 716 and 717). These designs involve no short bends; in plans requiring sharper bends it may be necessary to resort to heating and retreating. Bethlehem heat-treated crossings in service for more than three years under high-speed, main-line traffic on an eastern railroad are reported to show high wear resistance and to afford good riding qualities with low expenditures for maintenance.

Because this heat-treatment of rails has been shown to alter the physical properties of the metal uniformly throughout the entire cross section, the manufacturer recommends the use of these heat-treated rails in the manufacture of switch points. Service tests are said to support claims for high strength and resistance to wear in these units under traffic.

Shielded Arc Electrodes

THE Air Reduction Sales Company, New York, which is interested in electric arc as well as oxy-acetylene welding, has developed a new line of shielded-arc electrodes, which it has designated as Airco No. 78, 79 and 81 electrodes. All three electrodes are heavily coated and are suitable for a wide range of welding work, although the No. 81 is intended only for flat welding, while the two other electrodes can be used equally well in flat, vertical and overhead work.

The heavy coating on the No. 78 and 79 electrodes is said to cause a quiet arc and smooth flow of the molten metal at speeds two to four times as fast as is possible with ordinary bare or lightly coated electrodes. Tests of welds made with these two electrodes have shown a tensile strength of from 60,000 to 75,000 lb. per sq. in. and an elongation of 22 to 30 per cent in 2 in.

The No. 81 electrode, with an exceptionally heavy coating, produces the same welding characteristics as the No. 78 and 79 electrodes, and the resulting welds are said to have the same physical properties, except that elongation usually runs about 5 per cent greater. The No. 78 and 81 electrodes are furnished in sizes from 1/8 in. to 3/8 in., while the No. 79 is furnished only in the 3/16-in. size.

Spike Puller Is Improved

A NUMBER of improvements have been made by the Ingersoll-Rand Company, New York, in its SP9 pneumatic spike puller. One of these involves the incorporation of a lever-type throttle on one of the hand grips, in place of the roll type throttle which was a feature of previous models. The lever-type throttle is said to permit the operator to use easy straight-line motions in operating the puller.

The New Spike Puller

The spike-pulling cycle begins at the end of the pulling operation when the jaws are in the raised position. As the operator lifts the puller to place it over the next spike, he depresses the throttle lever which causes the jaws to move down to receive the next spike head. When the puller is in position with the jaws engaging the spike head, the operator releases the throttle lever, causing the jaws to lift in the pulling operation. A spike-ejecting finger, another new feature, kicks the hanging spike from the jaws and the puller is then prepared to receive the next spike.

What Our Readers Think

How Many Coats of Paint?

Madison, Wis.

To the Editor:

I have read with much interest the discussions on pages 100 and 101 of your February issue, relating to the number of coats of paint that should be applied on new wood surfaces and on old surfaces when repainting. For the past 12 years the Forest Products Laboratory has been studying these questions actively, both by practical experimental work of its own and by careful observation of practices and experience in house painting. It has found that certain aspects of the question were not fully covered by those who contributed to this discussion.

There can be no doubt that, as a rule, it is best to apply three coats for the initial painting of exterior woodwork. Large corporations, such as the railways, undoubtedly follow this practice consistently, as the correspondents indicated. On small residences in most parts of the country, however, two-coat initial painting has been practiced widely for a number of years and, on the whole, our observations fail to bear out Mr. Hartley's contention that "three coats of paint will last about twice as long as two coats." It will be wise, therefore, to study the facts a little more closely before concluding that two-coat initial painting is always impracticable.

It must not be assumed that two-coat initial painting represents merely the omission of one coat of the conventional three-coat job. If it did, two-coat painting would fail to hide the surface satisfactorily and would usually present uneven gloss and color. Two-coat painting is a completely redesigned painting system intended to effect application of the necessary amount of paint with less labor. Since Mr. Hartley, who contributed to the discussion, quoted the recommendations of the National Lead Company for three-coat painting with soft-paste white-lead paint, I shall use these as a basis for certain comparisons with acceptable two-coat painting, which are presented in Tables 1 and 2. Mr. Hartley omitted the specification of spreading rate, without which no recommendation of paint mixtures means very much, but I have supplied the spreading rates from the 1934 edition of the National Lead Company's "Handbook on Painting," page 13. It should be mentioned that soft-paste white lead consists of 89 per cent by weight of basic carbonate white lead, 9 per cent linseed oil and 2 per cent turpentine, and that 100 lb. of it contain by volume 1.57 gal. of pigment, 1.16 gal. of linseed oil and 0.28 gal. of turpentine.

For acceptable two-coat painting, it is essential that the first coat shall prime the wood adequately and leave a surface that will not absorb oil from the finish coat. Absorption of oil by an inadequately primed surface is irregular, greater on some parts of the surface than on others, and leaves a finish coat of uneven pigmentation that soon develops spotty discoloration with dirt, spotty chalking and fading, and is impaired in durability. The first coat of the conventional three-coat job is designed chiefly to make it easy for the painter to avoid laps; it need not, and in general it does not, prime the wood adequately because the second coat makes up for its deficiencies in this respect and provides a certain margin of safety besides. In two-coat painting, however, the first coat must prime the wood adequately and without fail, because there is no intermediate coat to make up for any such deficiences. For that reason the priming coat for two-coat painting must be mixed with much pigment and only enough turpentine to insure that the paint will wet the wood promptly, and it must be applied generously. Table 2 shows that the priming coat for two-coat painting, despite its higher content of pigment, applies nearly 50 per cent more linseed oil per 100 sq. ft. of surface than the conventional priming coat for three-coat painting, and in addition applies nearly twice as much pigment to hold the oil against the "suction" of the wood.

The completed films, after evaporation of the volatile components, contain approximately the same amounts of pigment and of linseed oil and are about the same in thickness, whether applied by the three-coat or the two-coat technic. As Mr. Hartley points out, the films are about 1/200 in. in thickness. The serviceableness of the two-coat jobs built up in this way is attested primarily by the many houses that have been painted in this way with thoroughly acceptable results,

but for closer technical comparison of two-coat and three-coat painting the Forest Products Laboratory has repeatedly made use of test fences. Those interested in the details of such tests are referred to the Paint, Oil and Chemical Review for December 13, 1934, page 12, or the American Paint Journal for December 10, 1934, page 7.

The disadvantage of the two-coat technic lies in the greater skill and understanding required of the painter. There is more trouble in avoiding laps with the thick mixture necessary for adequate priming, especially if too much turpentine is added to the mixture, and a painter's holiday in the primer stands out conspicuously in the completed job. It is wise, therefore, to recommend three-coat initial painting, but at the same time the possibilities of the two-coat technic in the hands of good painters should not be ignored.

Mr. Cunniff's suggestion that changes in the priming-coat mixture are necessary to suit the texture of different woods has long been accepted in principle by many authorities but, unfortunately, there have always been gross discrepancies in the assignments of specific woods to the more and less "absorptive" classes. Mr. Cunniff, for example, puts cedar and cypress in the same class with southern yellow pine, and redwood with spruce and white pine. If any such distinctions are to be drawn, cedar, redwood and the types of cypress most often painted, belong in the more "absorptive" group for which the priming coat should be mixed with practically no turpentine at all. White pine and spruce should be considered somewhat less "absorptive," while southern yellow pine and Douglas fir should be put in the least "absorptive" group. For no wood, however, should the priming coat be mixed with more turpentine in proportion to linseed oil than is given in the recommendation of the National Lead Company in Table I. As a matter of fact, the attempt to alter priming-coat mixtures for different woods usually leads to more harm than good. It is thoroughly practicable and much safer to use one good priming mixture for all woods. If more durable coatings are desired on southern yellow pine and Douglas fir, they can be achieved best by priming with aluminum paint and then applying two coats of white paint over the aluminum paint.

The number of coats required in repainting varies greatly with the nature and condition of the old coating. Fully as much harm can be done by applying too many coats as by applying too few. Old paints that are not yet chalking fairly freely are not ready for repainting at all. The best maintenance practice allows the old coating to wear down materially and aims to avoid building up a very thick layer of paint in the course of years. If the old paint is chalking freely, but only superficially, and has not worn down much, it is better to apply only one coat of new paint and it may be necessary to wash the surface before applying it. If the old coating is chalking deeply and is checking markedly but has not begun to flake or scale from the wood, two coats are usually advisable, although an experienced painter may still be able to do a good job with one reasonably heavy coat.

In repainting, it is always desirable to use paint of much the same pigment composition, both as to kind and amount, as the old paint. Good paints are not necessarily compatible with each other. The thoroughly reliable pure white-lead paint, if applied over certain paints of harder pigmentation, may quickly develop surprising and undesirable eccentricities. Almost any white or light colored paint may crack and chip badly and even scale off, if applied over an old paint of dark color and low pigmentation. When a building has been maintained for a number of years, using a different type of paint at each repainting, there is no telling what may happen except that the outcome will probably prove unsatisfactory. A year or so ago I had an excellent opportunity to observe the disastrous results of repainting with a paint incompatible with the previous paint, during a journey of some 2,000 miles over a transcontinental railroad that apparently had changed the color scheme on the wood buildings around its stations a short time previously. The results could be fully appreciated without leaving the Pullman car.

F. L. Browne,
Senior Chemist,
U. S. Forest Products Laboratory.

Table I—Comparison of Mixing Directions and Spreading Rates for Three-Coat and Two-Coat Initial Painting

Coat	Liquids to be added to 100 lbs. of soft-paste white lead: Linseed oil Gallons	Turpentine Gallons	Liquid drier Gallons	Area to be covered with one gallon of the mixture Square Feet
Recommendations of National Lead Company				
First	4	1.75	0.12	600
Second	1.5	1.25	0.12	700
Third	3	0	0.12	700
Acceptable two-coat painting				
First	3	0.75	0.12	450
Second	2.75	0	0.12	500

Table II—Volume of Paint Applied and Thickness of Film in Three-Coat and Two-Coat Initial Painting

Coat and film thickness	Volume of paint ingredients applied according to: National Lead Company directions: Pigment	Linseed oil	Volatile	Acceptable two-coat painting: Pigment	Linseed oil	Volatile
	Cu. in. per 100 sq. ft.			Cu. in. per 100 sq. ft.		
First coat	6.81	22.35	9.31	11.71	31.1	8.58
Second coat	8.81	14.92	9.26	12.34	30.7	3.14
Third coat	8.45	22.38	2.18	.....	.....	.....
Total film	24.07	59.65		24.05	61.8	
Total volume		83.72			85.85	
Thickness of dried film		0.0058 in.			0.0060 in.	

Standardization

(Continued from page 220)

tude to provide a choice which will meet the needs of the small minority which now insists on its own designs.

Studies of these three tools indicate quite clearly that there is a need for a marked reduction in the number of designs for each. It is equally clear, however, that rigid standardization is not necessary for economy, for if the number of designs can be reduced along the lines suggested, manufacturers will be able to effect the same economy in production that would be possible through concentration on a single design for each tool. In fact, as has been shown, it is doubtful whether a single design for either of these tools could obtain acceptance.

If the reduction is made with due regard to providing a suitable number of designs to meet the varying needs of the roads, all of the fundamental features of the individual designs will be retained. Simplification in the design of lining bars, tamping bars and claw bars, therefore, possess all of the advantages of standardization, without its disadvantages.

News of the Month . . .

300 Millions for Grade Separation

Appropriations of $300,000,000 for railroad grade crossing elimination, $400,000,000 for state highways and $300,000,000 for rural roads are proposed in a bill which was favorably reported to the House of Representatives by the House Committee on Roads on March 14. These appropriations would be apportioned by the Secretary of Agriculture to the states. That for grade crossings would be apportioned to the states as follows: 50 per cent on the basis of population; 25 per cent on the basis of federal-aid road mileage; and 25 per cent on the basis of railroad mileage.

Capital Expenditures Show Increase in 1934

Gross capital expenditures made by the Class I railroads for roadway and structures in 1934 totaled $120,707,000, compared with $88,493,000 in 1933 and $130,823,000 in 1932, according to the Association of American Railroads. Gross capital expenditures for locomotives, freight and passenger train cars and other equipment in 1934 totaled $92,005,000, as compared with $15,454,000 in 1933, and $36,371,000 in 1932. Total gross capital expenditures of $212,712,000 were greater than for any year since 1931 and compared with $103,947,000 in 1933 and $167,194,000 in 1932.

Opposes Government Ownership of Railroads

In a recent address on "Government ownership or What?" John J. Cromwell, general counsel of the Baltimore & Ohio, declared that government ownership of the railroads in the United States would lead ultimately to communism. While discussing the government ownership bill prepared by Senator Wheeler, Mr. Cromwell pointed out that no country has ever adopted government ownership as a deliberate or preferred policy. Foreign nations, where it exists, have it as a necessity, he said, adding that every argument and every experience in this country and abroad was against government ownership.

Lists 2,296 Available Grade Crossing Projects

A total of 2,296 grade crossing elimination projects, the total cost of which is estimated at $333,800,000, is included in a national inventory of available public works projects made by the Public Works administration, according to an announcement made by Harold L. Ickes, administrator of public works. Nearly 60,000 projects of various kinds with an estimated cost of $8,500,000,000 have been listed by PWA state engineers and state planning boards, according to the statement. The survey was ordered by administrator Ickes for the purpose of obtaining up-to-date information as to available projects which might be useful in connection with President Roosevelt's program for work relief and the development of natural resources.

Pennsy Increases Maintenance Expenditures

Increased expenditures for labor and materials amounting to nearly $7,200,000 were made in the maintenance of the roadbed, bridges, buildings, cars and locomotives of the Pennsylvania during 1934, as compared with the previous year. The increase amounted to 8 per cent and brought the aggregate outlay for maintenance on this road to $96,600,000 for the year. The additional expenditures consisted of $4,000,000 for maintenance of way and structures, an increase of 15 per cent, and $3,200,000 for maintenance of equipment.

The additional maintenance expenditures during the year included increases of $672,000 for bridges, trestles and culverts; $279,000 for ties; $396,000 for rails, other track material and ballast; $673,000 for track laying and surfacing; $641,000 for station and office buildings; $579,000 for signals and interlocking; $493,000 for shop machinery; $1,495,000 for steam locomotive repairs; and $801,000 for passenger train car repairs.

Few Large Systems Favored by Ralph Budd

Consolidation of our railroads into a limited number of systems was advocated as one means of solving the railway problem by Ralph Budd, president of the Chicago, Burlington & Quincy in a recent address at the University of Cincinnati. Since it appears that little can be expected in the way of corporate amalgamations, Mr. Budd advocated the setting up of a small number of railway operating companies, each of which would take over several existing railway properties for operation. Under such a system the owning corporations would be perpetuated but their physical properties would be leased to the operating companies.

Mr. Budd also stressed the need for the regulation of highway carriers and said that the added cost of constructing highways in order to permit them to carry heavy buses and trucks should be assessed so far as possible against the users on whose account it is incurred. In answering railway critics who contend that the railways and their managements are decadent, Mr. Budd cited the tremendous improvements that have been made in the design and construction of motive power and rolling stock and pointed to scientific research along various lines that has been carried out by the railways.

Railway Net Drops in January

The net railway operating income of the Class I railroads in January amounted to $21,348,557, which was at the annual rate of return of 1.50 per cent on their property investment, as compared with a net of $31,058,275, or 2.16 per cent, in January, 1934. Operating revenues for January amounted to $264,213,172, compared with $258,014,517 in the corresponding month last year, an increase of 2.4 per cent. Operating expenses totaled $212,971,508, as against $195,866,222 in the same month last year, an increase of 8.7 per cent. In January the Class I railroads paid $19,868,948 in taxes, a decrease of $766,326, or 3.7 per cent under the same month last year. Sixty-one Class I railroads operated at a deficit in January, of which 13 were in the Eastern district, 15 in the Southern district and 33 in the Western district.

Railroad Employment Shows Increase in 1934

In 1934 the average number of employees on the Class I railroads of the United States, excluding switching and terminal companies, was 1,008,995, according to a tabulation issued by the Interstate Commerce Commission. This figure compares with an average of 970,893 employees in 1933, and 1,031,914 in 1932. Including switching and terminal companies the average for 1934 was 1,025,155, as compared with 986,573 in 1933, and 1,048,568 in 1932. These figures represent the number of employees as of the middle of each month. The average number of employees who received some pay during the month increased from 1,086,595 in 1933, to 1,119,678 in 1934, or 3.04 per cent. The total compensation paid to employees was $1,544,219,621 in 1934, as against $1,427,293,251 in 1933 and $1,535,927,792 in 1932.

Additional Rail Orders

Activity in the rail market has been sustained during the last month, with a number of railroads placing orders for rails and fastenings and others contemplating purchases in the near future. The New York Central Lines have placed orders for approximately 20,000 tons of new rail and angle bars for use during 1935. This tonnage, which will cost $1,042,000, has been divided among the Bethlehem Steel Company, the Illinois Steel Company, and the Algoma Steel Corporation. Orders for track fastenings and accessories totaling $686,583 have also been placed by this company. The Gulf, Mobile & Northern has ordered 3,218 tons of rails and 700 tons of accessories from the Tennessee Coal, Iron & Railroad Company, while the Virginian has ordered 2,200 tons of rail from the Bethlehem Steel Company. The Southern Pacific has ordered 6,000 tons of tie plates

from the Columbia Steel Company. The following railroads are expected to enter the market soon for the tonnages given: Chicago & North Western, 25,000 tons rail and 8,000 tons fastenings; Union Pacific, 19,000 tons rail and 5,000 tons fastenings; Chicago Great Western, 5,000 tons rails; Kansas City Southern, 2,000 tons rail; and Pere Marq., 200 tons tie plates.

Students Compete in Bridge Design Contest

Ninety-four students representing twenty-two colleges in the United States participated in the seventh annual students' bridge design competition of the American Institute of Steel Construction. The subject of the competitive design this year was a steel grade crossing elimination bridge that carries a highway over a railroad and another highway parallel to the railroad. It is required that the structure provide connections for two lanes of traffic between the upper and lower highways, which must be so arranged that the lines of traffic do not cross. The surrounding country is flat and the maximum grades on the approaches and highway connections are not to exceed 5 per cent. The bridge provides for three lanes of traffic and as the structure is located in the open country there is no provision for sidewalks.

A jury of nationally-known engineers and architects selected the ten best drawings from the preliminary entries for final consideration on May 1. From these ten, the jury will select a prize winner who will receive $100 in cash. There will be a second prize of $50, and certificates of merit will be given those winning third, fourth and fifth places.

Pelley Says Railroads Do Not Need Co-Ordinator

"Since the railroads have established an authoritative organization to manage their own affairs within the industry the office of federal co-ordinator is no longer needed," said J. J. Pelley, president of the Association of American Railroads in a radio address on March 7. Furthermore, he said, "the railroads object to the idea of a federal co-ordinator with power to exercise authority without responsibility in the domain of management."

"All we ask," he continued, "is that Congress and the state legislature give us equality of opportunity in the field of competition with other forms of transportation and also prevent the enactment of burdensome legislation. Given these things, the rising tide of prosperity will find the railroads again on a sure foundation and contributing to increased prosperity through a volume of purchases probably unequalled by any other single industry."

In discussing government regulation of transportation Mr. Pelley contrasted the state of the railways with that of transportation by highway and waterway. Railway rates, he said, are fixed by the Interstate Commerce Commission and subject to change only after 30 days' notice, while highway carriers are free to bargain for traffic by changing their rates without notice. He also pointed out the inequalities in the taxation of the various transport agencies.

Association News

Wood-Preservers Association

The executive committee met in Chicago on March 15 with seven members present. Primary consideration was given to the perfection of the committee organization. Several subjects were selected for presentation as individual papers at the next convention.

Maintenance of Way Club of Chicago

Seventy-five members and guests attended a meeting on March 20 when Victor F. Larson, representative, Nordberg Manufacturing Company, gave an informal talk on the Russian Railroads and their methods of handling track work.

American Railway Engineering Association

As a result of action taken by the Board of Directors in a meeting held immediately after the close of the convention on March 14, the association will proceed with plans for a three-day convention in 1936, the dates selected being March 10, 11 and 12. The convention will be held at the Palmer House, Chicago.

The board also organized its committees for the current year, appointing the following chairmen: Outline of Work, George S. Fanning, chief engineer, Erie; Personnel of Committees, John V. Neubert, chief engineer maintenance of way, New York Central Lines; Publications, W. J. Burton, assistant to chief engineer, Missouri Pacific; Manual, John E. Armstrong, assistant chief engineer, Canadian Pacific; Library, W. F. Cummings, assistant chief engineer, Boston & Maine; Finance, A. F. Blaess, chief engineer, Illinois Central; Membership, R. C. Bardwell, superintendent of water supply, Chesapeake & Ohio.

The committees on Outline of Work and Personnel have completed the assignment of subjects and the appointment of committee members, and the bulletin containing this information will be mailed to the committees about April 1. Five changes in committee chairmen have been made as follows: A. D. Kennedy, assistant engineer, Atchison, Topeka & Santa Fe, succeeds A. P. Crosley, division engineer, Reading, as chairman of the Committee on Ballast; John Foley, forester, Pennsylvania, succeeds W. J. Burton, assistant to chief engineer, Missouri Pacific, as chairman of the Committee on Ties; C. H. Tillett, signal engineer, Canadian National, succeeds P. M. Gault, signal engineer, Missouri Pacific, as chairman of the Committee on Signals and Interlocking; A. P. Wenzell, special engineer, New York Central, succeeds D. J. Brumley, chief engineer, Chicago terminal improvements, Illinois Central (retired), as chairman of the Committee on Waterways and Harbors; and E. M. Hastings, chief engineer, Richmond, Fredericksburg & Potomac, succeeds J. C. Irwin, valuation engineer, Boston & Albany, as chairman of the Committee on Standardization.

Following the custom of recent years, an increasing number of committees held meetings during the March convention, either to give last-minute consideration to their reports or to organize for the coming year. Among those holding meetings at this time were the committees on Ties; Rail; Track; Masonry; Records and Accounts; Rules and Organization; Water Service, Fire Protection and Sanitation; Yards and Terminals; Wood Preservation; Uniform General Contract Forms; Economics of Railway Operation; Economics of Railway Labor; and Waterways and Harbors.

Only one committee has scheduled a meeting during April, this being the Committee on Economics of Railway Labor, which will meet at Detroit, Mich., on April 16.

The Bridge and Building Association

Approximately 45 members of the association took advantage of their attendance at the convention of the A.R.E.A. and the exhibit of the N.R.A.A. to lunch together at the Davis store, Chicago, on Wednesday, March 13.

At the conclusion of the luncheon, a meeting of the executive committee was held at the Palmer House, with President H. I. Benjamin, Vice-Presidents T. H. Strate, E. C. Neville, A. B. Scowden and W. R. Roof, Secretary-Treasurer C. A. Lichty, Directors C. A. J. Richards, C. M. Burpee, R. P. Luck and L. C. Smith, and Past Presidents Maro Johnson and Elmer T. Howson present. The recommendation of the Committee on Hotel Facilities that the Stevens hotel be selected as headquarters for the next convention was approved. It was decided to dispense with the annual dinner during the convention and to substitute therefor a luncheon, with a speaker of prominence, on the second day. Owing to his leaving railway service, J. J. Davis asked that he be relieved of the chairmanship of the Committee on Highway Bridge Floors and T. H. Strate (C.M.St.P.&P.) was appointed chairman in his stead, Mr. Davis continuing on the committee as vice-chairman. President Benjamin appointed Elmer T. Howson, C. R. Knowles and Secretary C. A. Lichty as a committee on arrangements for the next convention. Secretary Lichty reported that the proceedings are now in the hands of the printer and should be ready for distribution to the members during March. Ten applications for membership were presented and approved. President Benjamin then outlined plans for a drive to bring the association to the attention of eligible railway officers with the objective of interesting them in membership.

Plant Conditioning—The Sherwin-Williams Company, Cleveland, Ohio, has issued an attractively illustrated spiral-bound booklet bearing this title, which describes how the proper use of paint on interiors will promote safety, economy and efficiency on the part of employees. The booklet also describes the various finishes and their applications that are manufactured by this company.

(Continued on next left-hand page)

WOODINGS
RAIL ANCHOR

Low First Cost
Low Installation Cost
Great Holding Power
Efficient Upon Re-Application
Does Not Damage Rails or Ties
Millions in Service

WOODINGS FORGE & TOOL CO.
VERONA, PA.

Personal Mention

Engineering

Daniel J. Brumley, chief engineer, Chicago Terminal improvements, of the Illinois Central, with headquarters at Chicago, retired on April 1. Mr. Brumley had been connected with the Illinois Central continuously for 30 years. He was born on March 19, 1865, at Belmore, Ohio, and received his higher education at Ohio State University, from which he graduated in 1895. Mr. Brumley first entered railway service on June 18, 1895, as an assistant

Daniel J. Brumley

track foreman on the Louisville & Nashville. After a short period of service in 1896 with the Columbus & Hocking Valley Coal & Iron Company, he returned to the L. & N. as assistant supervisor at Belleville, Ill., then serving successively at various points as a track foreman, rodman and assistant engineer until 1901. For a short period in that year Mr. Brumley served as roadmaster on the Mexican National (now National of Mexico) at Laredo, Tex., then returning to the L. & N. as roadmaster at Elizabethtown, Ky. Three years later Mr. Brumley went with the Indianapolis Southern (part of the Illinois Central) as division engineer at Indianapolis, Ind. In March, 1905, he was appointed principal assistant engineer of the Illinois Central at Chicago. Five years later he was made engineer of construction and in April, 1913, he was appointed engineer maintenance of way. In November of the same year Mr. Brumley was advanced to assistant chief engineer and in April, 1914, he was appointed valuation engineer. During federal control of the railroads Mr. Brumley served as chief corporate engineer and at the end of this period he was made chief engineer in charge of electrification and other improvements in the Chicago Terminal zone, which position he held until his retirement. Mr. Brumley has been especially active in civic and professional affairs, serving among other capacities as president of the American Railway Engineering Association in 1927-28 and of the Western Society of Engineers in 1932-33.

W. G. Powrie, an assistant engineer on the Chicago, Milwaukee, St. Paul & Pacific, with headquarters at Chicago, has been appointed engineer of water service, with the same headquarters. This position has been vacant since the death of **Charles H. Koyl,** the previous incumbent, on December 18, 1932. Mr. Powrie was born on August 5, 1904, at Milwaukee, Wis., and first entered railway service in 1920, with the Milwaukee, at which time he served for three months. He returned to the service of this road in 1923, as a chairman in the district engineer's office at Minneapolis, Minn., being advanced successively through the positions of rodman and instrumentman. In 1928, Mr. Powrie was promoted to assistant engineer at Mason City, Iowa, and on January 1, 1930, he was appointed assistant to the general supervisor of bridges and buildings at Chicago. In 1931 he was advanced to division engineer of the Iowa & Southern Minnesota division, with headquarters at Austin, Minn., being transferred to Savanna, Ill., later in the same year. In August, 1932, Mr. Powrie was appointed assistant engineer at Chicago, in which position he has been in charge of water service matters.

Track

W. L. Kelly, supervisor on the Erie, with headquarters at Paterson, N.J., has been promoted to general roadmaster of the Eastern District, with headquarters at 50 Church street, New York City.

John Rask has been appointed roadmaster on the Denver & Rio Grande Western, with headquarters at Gunnison, Colo., succeeding **John Gratton,** whose death is noted elsewhere in these columns.

J. M. Kirk, roadmaster on the Missouri Pacific at Osawatomie, Kan., has been transferred to Coffeyville, Kans., succeeding **W. F. Murray,** who has in turn been transferred to Osawatomie.

J. E. Crawford, a track inspector on the Kansas division of the Chicago, Rock Island & Pacific, has been promoted to roadmaster with headquarters at El Dorado, Ark., succeeding **Frank Kirk,** whose death is noted elsewhere in these columns.

Albert Olson, a track foreman on the Canadian Pacific at Grand Forks, B.C., has been promoted to roadmaster, with headquarters at Nelson, B. C., succeeding **Frank Lind,** deceased. **J. R. Sjobeck,** roadmaster, with headquarters at Macleod, Alta., who has been on an extended leave of absence, returned to his duties on March 1. **J. P. Rogianni,** who has been serving as roadmaster at MacLeod in the absence of Mr. Sjobeck, has been transferred to Aldersyde, Alta., succeeding **H. Olson,** who has been transferred to Consul, Sask. Mr. Olson succeeds **G. Talbot,** acting roadmaster, who has been assigned to other duties.

F. Roy, assistant engineer on the Canadian National, has been appointed acting roadmaster on the Dauphin division with headquarters at Dauphin, Man., succeeding **P. Harrison,** who has been transferred on the same division to The Pas, Man., replacing **H. H. Leathers,** who has been transferred to the Portage-Brandon division, with headquarters at Portage La Prairie, Man. Mr. Leathers succeeds **D. S. Davidson,** who has been transferred to Ft. Rouge, Man., where he replaces **G. Eyford,** who has retired.

Charles Pfeifer, who has been appointed supervisor of track on the Elgin, Joliet & Eastern, with headquarters at Joliet, Ill., as noted in the March issue, was born on April 26, 1879, in Cook County, Ill. He first entered railway service with the Elgin, Joliet & Eastern in April, 1897, as a trackman, serving in this position and as assistant track foreman until June 18, 1902, when he left railway service. On March 17, 1905, Mr. Pfeifer re-entered the service of the E. J. & E., serving as a track foreman and extra gang foreman at various points until his recent promotion to supervisor of track.

G. K. Sterling, an instrumentman on the Chicago & North Western, with headquarters at Chicago, who has been promoted to roadmaster with headquarters at Rapid City, S. D., as noted in the March issue, was born on November 15, 1900, at Escanaba, Mich. Following a public school education he entered railway service on May 20, 1917, as a rodman on the Chicago & North Western. Four years later Mr. Sterling was appointed a tapeman at Fond du Lac, Wis., and from March, 1923, to May, 1926, he served as a rodman and as a material clerk at various points. At the end of this period Mr. Sterling was appointed an instrumentman at Chicago, which position he was holding at the time of his recent promotion to roadmaster at Rapid City.

Dana Burroughs, whose promotion to track supervisor on the Portland division of the Boston & Maine, with headquarters at Dover, N.H., was noted in the March issue, was born at Wolfeboro, N.H., on June 6, 1899, and received his higher education at Brewster Academy, Wolfeboro. He entered railway service on May 8, 1916, as a trackman on the Portland division of the Boston & Maine, and in March, 1926, was promoted to assistant foreman on the same division. In April, 1927, he was promoted to foreman, and in April, 1928, he became general foreman on the Portland and Fitchburg division. In April, 1931, he was appointed acting assistant track supervisor on the Terminal division, and in October of that year he returned to his former position as foreman on the Portland division. In February, 1934, Mr. Burroughs was promoted to assistant track supervisor on the Portland division, and in April of that year he became acting track supervisor on the same division. In November, 1934, he returned to his former position of assistant track supervisor, which position he was holding at the time of his recent promotion.

Obituary

Frank Kirk, roadmaster and master carpenter on the El Paso-Amarillo and Arkansas-Louisiana divisions of the Chicago, Rock Island & Pacific, with headquarters at El Dorado, Ark., died on March 1 at

(Continued on next left-hand page)

The Guard Rail for today's traffic- *and tomorrow's*

This installation of the Hook-Flange Guard Rail on a prominent eastern railroad provides for a canted running rail.

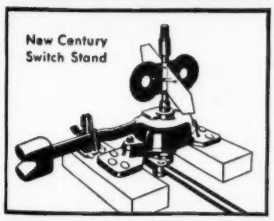
STRENGTH and resilience are the twin keys to the construction of guard rails or other track accessories that will bear up under the shocks resulting from fast operation of heavy trains. However strong a guard rail may be, unless it is resilient the repeated impacts of wheels may break it.

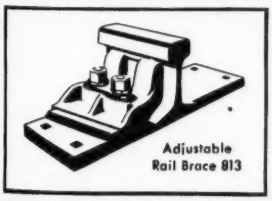
The Bethlehem Hook-Flange Guard Rail is made of rolled steel. With great strength it combines a high degree of resilience. When struck on the flare by the flange of a fast-moving wheel, this guard rail gives slightly, absorbing and dissipating the shock. The truck is straightened up smoothly, without damage to flanges or guard rail. The opposite wheels are guided accurately past the frog point.

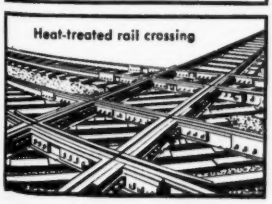
The present trend towards higher speeds for conventional equipment and super speeds with trains of new designs calls for these safe, durable Bethlehem Hook-Flange Guard Rails. For all practical purposes they can be considered unbreakable. The strength of the rolled steel enables it to stand extremely heavy stresses, while its resilience cushions the impacts.

Like the Hook-Flange Guard Rail, all other items of Bethlehem's line of Track Specialties are designed with careful consideration of operating conditions, based upon long contact with the railway field, and have proved their worth by years of service on representative roads.

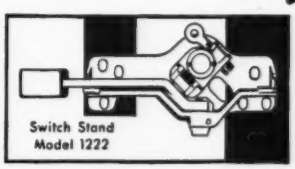
OTHER BETHLEHEM TRACK EQUIPMENT







BETHLEHEM *Track Equipment*



BETHLEHEM STEEL COMPANY

GENERAL OFFICES: BETHLEHEM, PA. *District Offices:* Atlanta, Baltimore, Boston, Bridgeport, Buffalo, Chicago, Cincinnati, Cleveland, Dallas, Detroit, Houston, Indianapolis, Kansas City, Milwaukee, New York, Philadelphia, Pittsburgh, St. Louis, St. Paul, Washington, Wilkes-Barre, York. *Pacific Coast Distributor:* Pacific Coast Steel Corp., San Francisco, Seattle, Los Angeles, Portland, Honolulu. *Export Distributor:* Bethlehem Steel Export Corp., New York.

St. Luke's hospital, Chicago. Mr. Kirk entered the service of the Rock Island on August 31, 1917, as an assistant engineer on track elevation work at Chicago. Later he was appointed an instrumentman on the Dakota division, being subsequently promoted to master carpenter on the same division. On August 1, 1924, Mr. Kirk was appointed also division engineer of the Dakota division and on January 1, 1931, he was appointed division engineer of the Nebraska-Colorado division, with headquarters at Fairbury, Neb. On January 1, 1932, he was appointed roadmaster and master carpenter on the El Paso-Amarillo and Arkansas-Louisiana divisions, which position he was holding at the time of his death.

John Gratton, roadmaster on the Denver & Rio Grande Western, with headquarters at Gunnison, Colo., died on January 31.

Elmer Irving, engineer maintenance of way on the Pennsylvania, Eastern Region, at Philadelphia, Pa., died on March 13, at Philadelphia. Mr. Irving was born on

Elmer Irving

January 4, 1878, at Trenton, N. J., and entered the service of the Pennsylvania as a rodman in the office of the assistant engineer in New York, on January 15, 1895. Later he enrolled in Cooper Institute and graduated from that institution in 1900. On July 20, 1901, Mr. Irving was appointed a draftsman on the New York division, and on April 25, 1902, he was advanced to transitman under the principal assistant engineer at Altoona, Pa. On January 1, 1903, Mr. Irving was further advanced to assistant supervisor of track on the West Jersey & Seashore (part of the Pennsylvania) with headquarters at Haddonfield, N. J., being subsequently transferred to New Florence, Pa. On August 1, 1905, he was promoted to supervisor of track, with headquarters at Osceola Mills, Pa., later being transferred to Earnest, Pa., and thence to Lancaster, Pa. On September 28, 1916, Mr. Irving was promoted to division engineer of the Trenton division, with headquarters at Camden, N. J., later being transferred to Harrisburg, Pa. In 1922 he was promoted to engineer maintenance of way, with headquarters at Williamsport, holding this position until 1928, when he was transferred to the office of the chief engineer maintenance of way of the Eastern region, at Philadelphia.

Supply Trade News

Personal

George H. Bucher, president and general manager of the **Westinghouse Electric International Company,** has been elected also a vice-president of the **Westinghouse Electric & Manufacturing Company,** with headquarters at New York.

John M. Mulholand, special representative of railroad sales at Chicago for the **Youngstown Sheet & Tube Company,** Youngstown, Ohio, has been appointed manager of railroad sales for the company. Mr. Mulholand's headquarters will continue to be at Chicago. He was born at

John M. Mulholand

Pittston, Pa., and after attending grammar and high schools in that state, he took a course in marine engineering at the University of Michigan, graduating in 1910. Mr. Mulholand followed engineering, principally mining work, and then served in the war, entering the service through the Officers Training School Tank Corps. From the close of the war until 1932 he was engaged in the railroad equipment field, first as district sales manager of Mudge & Company, and then as vice-president of sales of the O. F. Jordan Company. Mr. Mulholand has been with the Youngstown Sheet & Tube Company since December, 1932.

C. H. Rhodes, assistant general manager of sales of the bar, semi-finished and alloy steel division of the **Illinois Steel Company,** with headquarters at Chicago, has been appointed director of purchases of the **United States Steel Corporation,** with headquarters at New York. **Griswold A. Price,** who has been manager of sales at St. Louis since January 1 for the **Carnegie Steel Company,** the **Illinois Steel Company,** and the **Tennessee Coal, Iron & Railroad Company,** succeeds Mr. Rhodes at Chicago. **Robert Corson, Jr.,** succeeds Mr. Price at St. Louis. **William B. Weston,** manager of sales in the Detroit district for the Carnegie Steel Company, the Illinois Steel Company, and the Tennessee Coal, Iron & Railroad Company, has been appointed assistant to the vice-president and general manager of sales of the Carnegie Steel Company, with headquarters at Pittsburgh, Pa., and has been succeeded by **Philip M. Cuba,** assistant manager at Detroit, Mich.

C. B. Nolte, president and general manager of the **Robert W. Hunt Company,** Chicago, has been elected president of the **Crane Company,** Chicago, succeeding

C. B. Nolte

John W. Berryman, who has been elected chairman of the board of directors.

Mr. Nolte graduated from the University of Illinois in 1909 and soon afterward entered the employ of Robert W. Hunt & Co. He served as inspecting and testing engineer in various departments of this company until 1913, when he was appointed manager of the railway materials inspection and testing department. In 1919 Mr. Nolte was appointed assistant to the president and in 1923, when the company was incorporated under the name of the Robert W. Hunt Company, he was elected vice-president and general manager. He was elected president and general manager in 1930.

James C. Ogden, vice-president of the **Robert W. Hunt Company,** Chicago, has been elected president succeeding **C. B. Nolte,** president and general manager, whose election to the presidency of the **Crane Company** is noted elsewhere in these columns. **F. M. Randlett,** Pacific Coast manager for the Robert W. Hunt Company, has been elected vice-president and general manager, with headquarters at Chicago.

John S. Keefe, who retired from the presidency of the American Steel & Wire Company on January 1, 1933, died on March 3 at his home at Oak Park, Ill. Mr. Keefe was born on January 24, 1864, at Boston, Mass. At the age of 13 he became an office boy with the Chicago & North Western. In 1888 he left railway service to become traffic manager for the Illinois Steel Company, now a part of the United States Steel Corporation. In 1899 he was appointed general traffic manager of the American Steel & Wire Company, also a subsidiary of the United States Steel Corporation, and in 1901 became a director and first vice-president of that company. He was promoted to president in December, 1927, and retired under the corporation's pension plan on January 1, 1933, Mr. Keefe having requested that he be relieved of his duties on that date.

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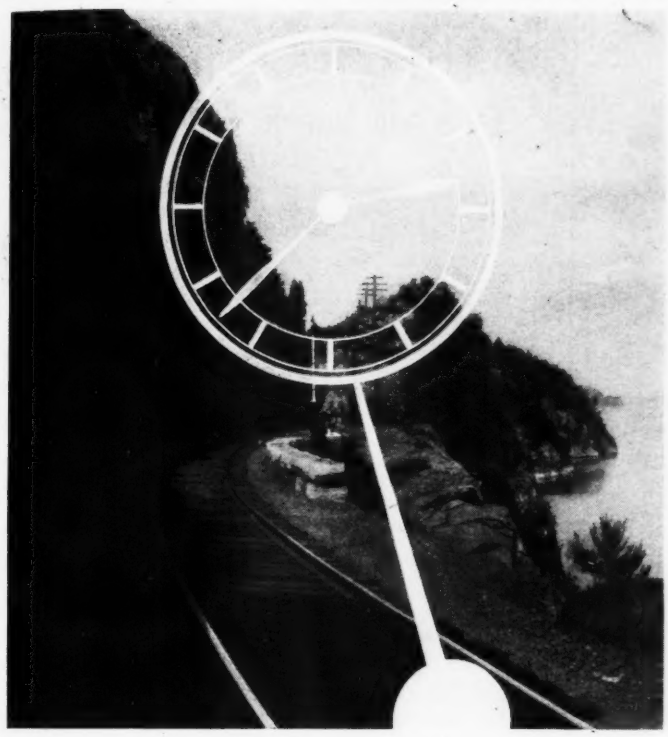

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Expenditures for improvements	$120,000,000
Total for roadway	$485,000,000

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$33,200,000 for rail
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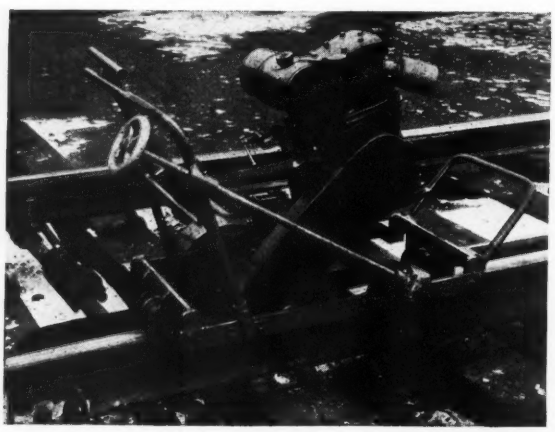

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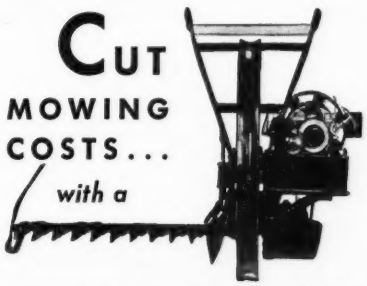

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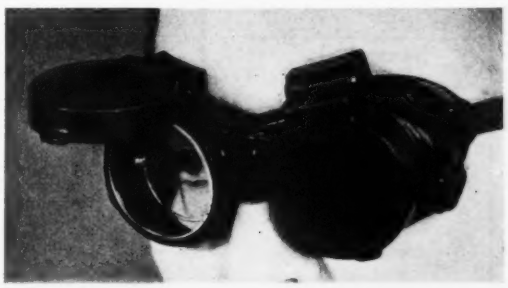

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ALPHABETICAL INDEX TO ADVERTISERS

A

Air Reduction Sales Co. 202
Armco Culvert Mfrs. Assn. 205

B

Bethlehem Steel Co. 247

C

Calcyanide Co. 253
Chicago Pneumatic Tool Co. 210

D

Dearborn Chemical Co. 250
Detroit Harvester Co. 253

E

Eaton Mfg. Co. 198

F

Fairbanks, Morse & Co. 204
Fairmont Railway Motors, Inc. 201

I

Illinois Steel Co. 206
Ingersoll-Rand Co. 249
Ingot Iron Railway Products Co. 205

L

Lundie Engineering Corp. 199

M

Maloney Oil & Mfg. Co. 254
Metal and Thermit Corp. 200
Morrison Metalweld Process, Inc. 209

N

National Lead Co. 255
National Lock Washer Co. 197
Nordberg Mfg. Co. 207

O

Oxweld Railroad Service Co. 203

R

Railway Track-work Co. 252
Ramapo Ajax Corp. 212

S

Simmons-Boardman Pub. Co. 250-251-252
Sinclair Refining Co., Inc. 254

T

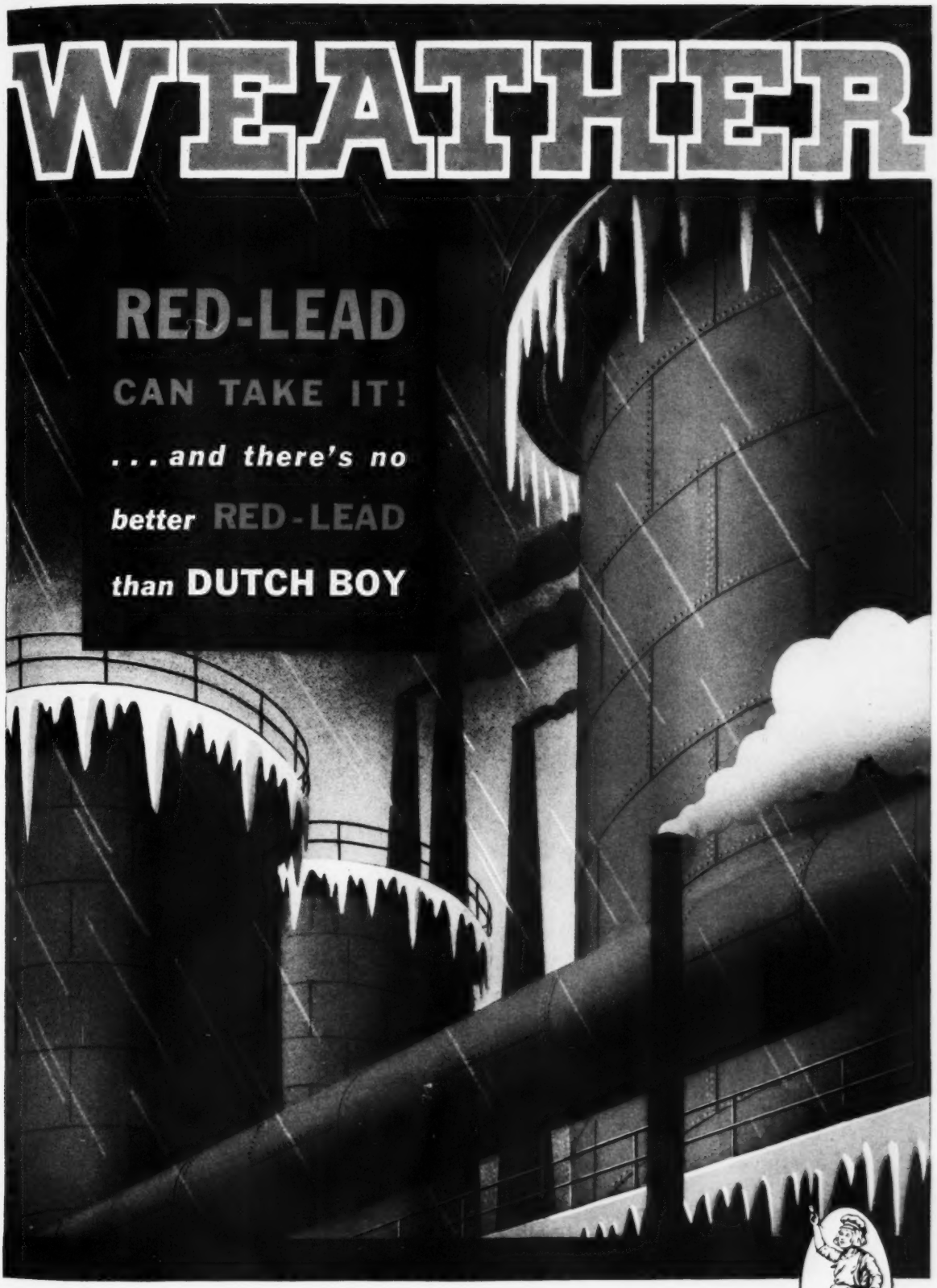
Timken Roller Bearing Co. 256

U

Union Carbide and Carbon Corp. 203

W

Warren Tool Corp. 250
Willson Products, Inc. 253
Woodings Forge & Tool Co. 245



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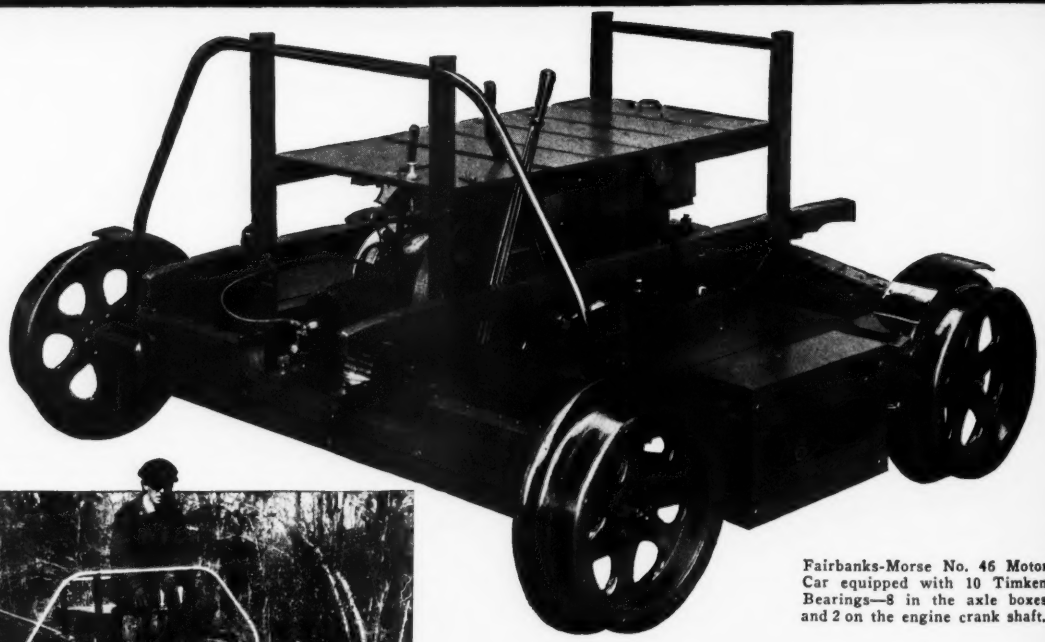

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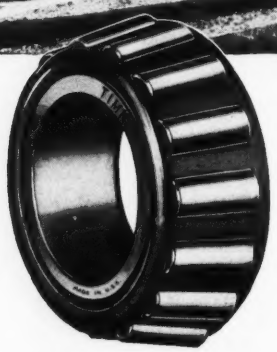

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